Invermere Timber Supply Area
Timber Supply Review #3

Analysis Report

Version 3.0

May 12, 2004

Prepared For:

Invermere Timber Supply Area
Defined Forest Area Management (DFAM) Group

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BC
Timber
Sales
CANFOR

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More Information on the Timber Supply Review Process

This document was prepared to support an allowable annual cut determination by British Columbia's Chief Forester. To learn more about this process please visit the following website:

http://www.for.gov.bc.ca/hts/

Or contact:

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Comments and Questions

Input from First Nations and public is an important part of the Timber Supply Review process and you are encouraged to review the information in this document and forward any comments to Forsite Consultants Ltd. by **July 24, 2004**.

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If you have any questions or would like further information, please contact Cam Brown, RPF or Craig Robinson, RPF at (250) 832-3366.

A public presentation of the Data Package is planned for the evening of **June 23, 2004** at the Invermere Inn (Best Western) in Invermere from 6:00 - 8:30 PM.

Additional copies of this document are available on the web at www.forsite-sa.com/InvermereTSR3/ or can be requested using the email address above.

Acknowledgements

Forsite would like to thank each of the parties that contributed to the TSR3 process in the Cranbrook TSA. The time and commitment provided by everyone contributed greatly to this document and allowed it to be completed in a timely fashion. We would like to specifically thank government staff for their timely provision of data and thorough review/approval process within expedited timeframes. We thank licensee staff for access to their time and prompt efforts in provided required information.

We also thank Al Neal, RPBio for his numerous contributions to the process and for his excellent job of contract administration/coordination.

We also want to recognize the contributions of the following firms in the delivery of this project:

- Derek De Biasio of Crane Management Consultants Ltd completed the socio-economic analysis included in this document, and
- Oliver Thomae, RPF of ArbourTech Forest Management Services and Reg Davis, RPF of Interior Reforestation Co. Ltd. assisted with the preparation of the data package.

Executive Summary

This document contains a timber supply analysis and socio-economic analysis specific to the Invermere Timber Supply Area (TSA). These analyses are an important part of the provincial Timber Supply Review (TSR) process. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TSA. A review of this type is completed at least once every five years in order to capture changes in data, practices, policy, or legislation influencing forest management in the TSA. The previous timber supply review (TSR2) was completed in February 2001 with a final Annual Allowable Cut (AAC) determination on September 1, 2001. This current review (TSR3) is working toward a new AAC determination to be in place before September 1, 2006.

The current allowable annual cut (AAC) for the Invermere TSA is 581,570 m3/yr (set September 1, 2001) and contains no partitions or woodlot license volume. This volume is currently allocated to Canadian Forest Products (Canfor) in Radium, Tembec Industries (Tembec) in Canal Flats, and BC Timber Sales (BCTS).

The TSR3 Data Package, a document providing detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis, was released on December 3rd, 2003 and then ultimately approved by Forest Analysis Branch on March 18, 2004. The release of this Analysis Report is the next step in the TSR3 process. Its purpose is to summarize the results of the timber supply analysis and provide a focus for public discussion. The contents of this report will provide British Columbia's Chief Forester with a large portion of the information that is needed to make an informed AAC determination.

This report focuses on a single forest management scenario that reflects current management practices in the Invermere TSA. In addition to this current management or "Base Case" scenario, an assessment of how results might be affected by land-base or forest management uncertainties has been completed using a number of sensitivity analyses.

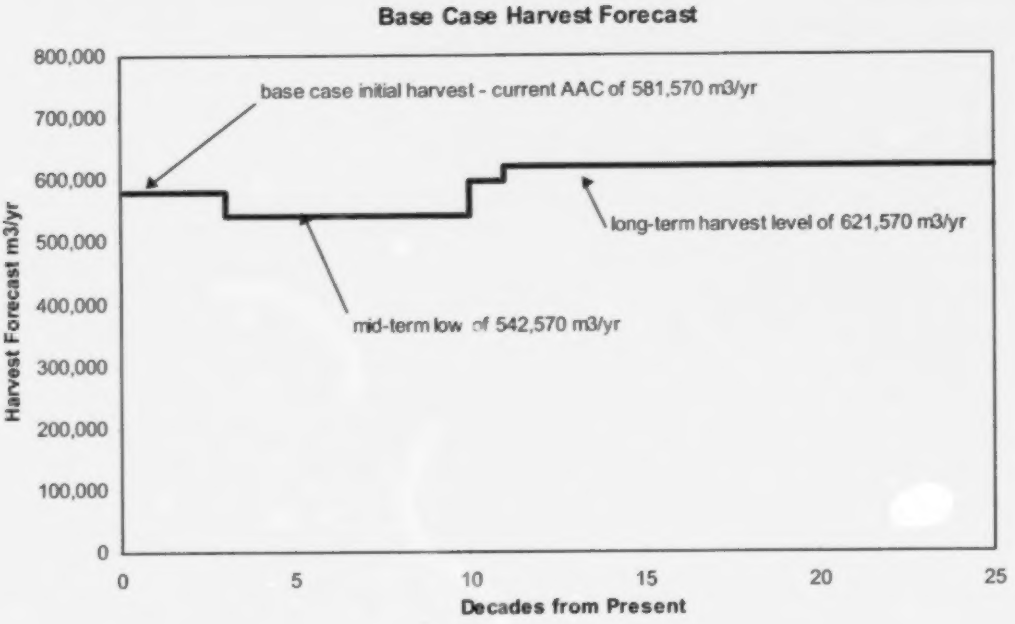
The Invermere TSA covers approximately 1.15 million hectares in the south-eastern corner of British Columbia. The portion of this area considered available for timber production and harvesting under current management practices is called the timber harvesting land base (THLB). The THLB has been estimated through the analysis of spatial map layers and assumptions detailed in the Data Package (Appendix B). The result is a description of the area that is available for timber harvesting under TSA administrative structures. Based on these inputs, the THLB is estimated to be 233,873 ha, a decrease of 3.3% (7,886 ha) since the last timber supply review. The main factors causing this are larger netdowns for riparian areas, problem forest types, low productivity sites, existing trails and landings, and a potentially larger inoperable area. This reduction was partially offset by fewer hectares removed as unstable terrain.

Since the last timber supply review for the Invermere TSA, many changes effecting forest management have occurred. The major changes are as follows:

- The Kootenay Boundary Higher Level Plan Order (October 26, 2002) gives legal status to Landscape Units, Biodiversity Emphasis Options with specific Old and Mature Retention Targets, Connectivity Corridors, Caribou Management Areas, Scenic Corridors, and Enhanced Resource Development Zones.
- Biogeoclimatic Ecosystem Classification (BEC) mapping for the Invermere TSA was revised in 2003.
- Operability for the TSA was reviewed in 2003, to confirm the merchantability and economic viability of accessing forest stands in the TSA.
- Visual Quality Objectives (VQO's) were made known by the District Manager in August 2003.
- The Kootenay National Park (KNP) has been included in the dataset and is considered part of the Crown Forest Land Base (CFLB).
- Predictive Ecosystem Mapping (PEM) has been completed for the TSA and used to adjust site index values based on ecological relationships. Average site index increased by 2.5m or almost 16%.

- New Visual Quality Objectives (VQO's) were make know by the District Manager of the Rocky Mountain Forest District in August 2003 and were used in conjunction with HLPO scenic areas.
- Less partial cutting is currently taking place in the TSA because of the silvicultural and timber supply challenges it presents.

This report summarizes a base case analysis of the Invermere TSA. The base case scenario was developed to reflect current forest practices in the TSA and the resulting harvest flow was guided by provincial policy. The base case harvest flow maintains the current AAC (581,570 cubic meters) for 3 decades and then drops by 9% to the midterm harvest level (542,570 cubic meters). It then rises to the long term harvest level of 621,570 cubic meters in the 11th decade. This long term level is 7% above the current AAC.



Sensitivity analysis of the base case revealed that both short-term and long-term harvest levels are sensitive to changes in input assumptions.

Uncertainties that could alter the short-term harvest level are:

- the size of the timber harvesting land base,
- the amount of volume currently existing on the land base, and
- the length of time it takes regenerated stands to become ready for harvest (minimum harvest ages).

Uncertainties that could alter the long-term harvest level by at least 3% are:

- the size of the timber harvesting land base,
- future managed stand yields,
- the length of time it takes regenerated stands to become ready for harvest (minimum harvest ages, regeneration delays),
- the rate at which slow growing older stands are converted to more productive managed stands,
- management guidelines for ungulate winter range, and
- the amount of select seed used and its genetic worth.

Although these sensitivities indicate that there is potential for the harvest forecast to change, the base case scenario is felt to best represent the current situation in the Invermere TSA. Looking forward, a number of changes are likely to improve timber supply in the mid- and long-term. These include new ungulate winter range guidelines and improved gains on select seed.

A socio-economic assessment of the importance of the forest industry to the Invermere TSA and the province was also completed. Based on facts and data collected, it was concluded that the base case harvest forecast of 581 570 m^3 (which extends for three decades) could annually support the following.

- estimated 446 PYs of total employment and $18.2 million of employment income in the Invermere TSA
- estimated 952 PYs of total employment and $36.9 million of employment income in the province
- estimated $8.2 million of stumpage revenues and $18.8 million of total BC Government revenues

Since the base case harvest forecast for several decades and the current AAC are the same there will be neither positive nor negative impacts for the regional economy unless the AAC stability contributes to decisions about capital investments in processing capability.

Small reductions in AAC would reduce the available annual timber supply but would not register a negative impact on the overall economy because the Invermere TSA economy is relatively diversified. Minor changes in the regional forest sector do not have significant consequences for the TSA's overall economic wellbeing.

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1.0 Introduction

Timber supply is the amount of timber available for harvest over time. Assessing timber supply involves consideration of a wide range of physical, biological, social, and economic factors that can influence the acceptable rate of timber harvesting within a management unit. These factors encompass both the timber and non-timber values found in our forests and ensure that timber harvesting objectives are balanced against concerns for wildlife, biodiversity, watershed health, recreational opportunities, etc.

This document contains a timber supply analysis and socio-economic analysis specific to the Invermere Timber Supply Area (TSA). These analyses are an important part of the provincial Timber Supply Review (TSR) process. The general objective of the TSR process is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TSA. A review of this type is completed at least once every five years in order to capture changes in data, practices, policy, or legislation influencing forest management in the TSA. The previous review (TSR2) was completed in February 2001 with a final Annual Allowable Cut (AAC) determination on September 1, 2001. The current review (TSR3) is therefore working toward a new AAC determination to be in place before September 1, 2006.

The Data Package, a document providing detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis, was released in December 2003[1] and ultimately approved by Forest Analysis Branch on March 18, 2004. The release of this Analysis Report is the next step in the TSR3 process. Its purpose is to summarize the results of the timber supply analysis and provide a focus for public discussion. The contents of this report will provide the British Columbia's Chief Forester with only a portion of the information that is needed to make an informed AAC determination. **This report does not define a new AAC – it is intended only to provide insight into the likely future timber supply of the Invermere TSA and recommend a future course of action to the Chief Forester.** The final harvest level decision will be made by the Chief Forester and published along with his rationale in an AAC Determination document.

This report focuses on a single forest management scenario that reflects current management practices in the TSA. In addition to this current management or "base case" scenario, an assessment of how results might be affected by uncertainties has been completed using a number of sensitivity analyses. Together, the sensitivity analyses and the base case form a solid foundation for discussions among stakeholders about appropriate timber harvesting levels.

1.1 Background

The Ministry of Forests (MOF) is currently implementing a policy framework that establishes obligations and opportunities for collaborative forest management within the province's 37 timber supply areas (TSA). This framework is commonly referred to as the Defined Forest Area Management (DFAM) initiative. Under DFAM, specified licensees and BC Timber Sales (BCTS) assume a collective responsibility for timber supply analysis and specified forest health activities within each timber supply area.

The Invermere DFAM group consists of Canadian Forest Products Ltd. (Canfor), Tembec Industries Inc. (Tembec), and B.C. Timber Sales (BCTS). This group has chosen to take on the responsibilities of timber supply and forest health with the knowledge that the Forest Investment Account is currently funding the initiatives (Table 1). Thus, for TSR3, the DFAM group is leading the Timber Supply Review process. To deliver on this commitment, the planning and analysis work associated with the TSR was tendered and subsequently awarded to Forsite Consultants Ltd. of Salmon Arm. In addition, the DFAM group contracted with Al Neal Environmental Consulting to fill a contract monitoring and co-ordination role.

Government agencies still play a key role in this TSR process – they set and enforce standards and are responsible for approval of the Data Package and Analysis Reports. The MoF provides technical support, facilitates resolution of issues, and validates technical information. Various resource specialists in the Ministries of Sustainable Resource Management (MSRM) and Water, Land and Parks (WLAP) also play key roles. The following table shows the general roles and responsibilities associated with the timber supply analysis leading to an AAC determination.

Table 1. Roles and responsibilities in the implementation of a DFAM TSR.

DFAM Group Obligations	**Government Obligations**	
	Forest Analysis Branch	**District And Regional Staff**
Compile data needed for the timber supply analysis, including forest cover and other data related to forest and land characteristics, administration and management regimes. Provide a summary of the data, management assumptions, and modeling methods to be applied in the timber supply analysis in a Data Package document.	Set standards for the data package	Provide data, information, and knowledge of current practices in the TSA.
Provide information to the public and First Nations and summarize comments received for government.		
Make any necessary changes to the data package and submit for government approval.	Review and accept the data package (focus on how data is to be applied in Timber supply analysis).	Review and accept the data package (focus on confirming current practice).
Perform and document a timber supply analysis according to standards provided by the Ministry of Forests.	Provide technical advice and set standards for the analysis and reporting.	
Submit an Analysis Report and digital file containing the complete dataset used in the timber supply analysis.	Review and accept (together with the Chief Forester) the analysis report.	Review the analysis report to ensure local issues and current practices are adequately reflected.
Provide information to the public and First Nations and summarize comments received for government.		Conduct formal consultation.
Provide additional information as required by the Chief Forester.	Compile and prepare information for presentation to the Chief Forester at the determination meetings.	Assist in compiling and preparing information for presentation to the Chief Forester at the determination meetings.

1.2 Guiding Legislation / Policy

For the Invermere TSA, the following legislation and policy guide management on the crown forested land base:

- Forest Practices Code of BC Act and /or Forest and Range Practices Act
- Kootenay-Boundary Higher Level Plan Order, October 26, 2002.
- Kootenay-Boundary Land Use Plan Implementation Strategy, 1997.
- District Manager's Instructions for Forest Development Plan Preparation, 2001.
- District Manager Direction Letter on Visual Quality Objectives, August 2003.
- Provincial Wildlife Tree Management Policy and Recommendation, 2000.
- Landscape Unit Planning Guide, 2000.
- Identified Wildlife Management Strategy, Feb 1999.

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[1] The Invermere TSR3 Data Package v1.0 was released in December 3, 2003 and was used for public and First Nations consultation. Version 2.1 was submitted to government for review on January 30, 2004. Version 3.0 was released March 8, 2004 and was approved by government on March 18, 2004.

2.0 Description of the Invermere Timber Supply Area

The Invermere Timber Supply Area (TSA) is within the Southern Interior Forest Region - Rocky Mountain Forest District and is administered out of the district office in Cranbrook. The Rocky Mountain Forest District is situated in the southeastern corner of British Columbia and was created in 2003 by amalgamating the old Invermere and Cranbrook Forest Districts. The district contains approximately 2.63 million hectares, of which 1.15 million hectares falls within the Invermere TSA.

The Invermere TSA is bounded by the Cranbrook TSA to the south, the Golden TSA and TFL 14 to the north, the Rocky Mountains / Alberta border to the east, and the Purcell Mountains to the west. Between these two mountain ranges lies the Rocky Mountain Trench, a broad, flat valley with numerous rivers and wetlands. The Columbia River flows north through the trench from Columbia Lake, creating a large, complex wetland ecosystem called the Columbia Wetlands.

The TSA includes one national park (Kootenay) and eleven provincial parks: Mount Assiniboine, Height of the Rockies, Top of the World, Purcell Wilderness Conservancy, Bugaboo Glacier, Windermere Lake, Whiteswan Lake, Premier Lake, Canal Flats, James Chabot, and Dry Gultch.

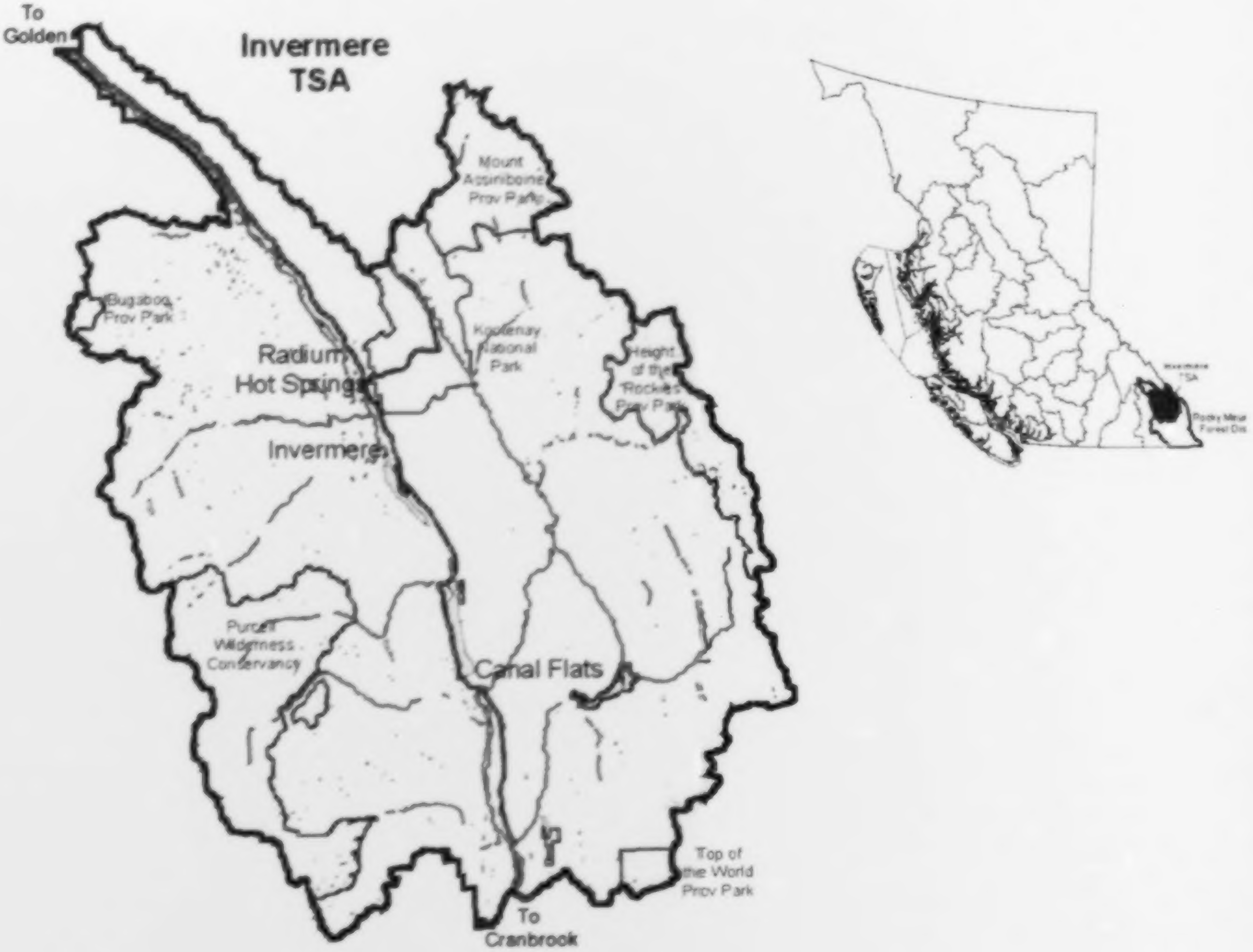
To Golden
Invermere TSA
Mount Assiniboine Prov Park
Bugaboo Prov Park
Kootenay National Park
Radium Hot Springs
Height of the Rockies Prov Park
Invermere
Purcell Wilderness Conservancy
Canal Flats
Top of the World Prov Park
To Cranbrook

Figure 1. Invermere Timber Supply Area

The major population centers in the TSA are Invermere, Windermere, Canal Flats, and Edgewater, while smaller communities include Radium Hot Springs, Wilmer, Fairmont Hot Springs, and Parsons. Canadian Forest Products currently operates out of Radium Hot Springs, while Tembec Industries' main local presence is in Canal Flats.

The Invermere TSA offers many and varied opportunities for recreation and tourism, due to its lakes, parks and spectacular mountains. The area provides a wide range of front- and back-country recreational opportunities including mountain biking, hiking, climbing, fishing, camping, wildlife viewing, whitewater boating, heli-skiing, snowmobiling, ski mountaineering, cross country skiing, and downhill skiing. The TSA also contains significant water resources. Numerous watersheds are classified as either domestic or community watersheds.

The current allowable annual cut (AAC) is 581,570 cubic meters and no partitions currently exist. The previous review (TSR2) reduced the AAC by 9,930 cubic meters in consideration of area lost to woodlot licenses since TSR1.

2.1 First Nations

Most First Nations people in the Invermere TSA are part of the Ktunaxa people. They have traditional territory within the TSA, and archaeological evidence suggests the Ktunaxa have inhabited the East Kootenay region since the last glaciation over 10,000 years ago. Two First Nations communities exist in the TSA, the Columbia Lake Band at Windermere and the Shuswap Band at Invermere. The Shuswap people are culturally and linguistically aligned with the Shuswap Nation and politically aligned with the Ktunaxa Kinbasket Tribal Council.

The Ktunaxa-Kinbasket Tribal Council, on behalf of the Ktunaxa Nation and Shuswap Indian Band, have submitted a comprehensive land claim that covers the southeast corner of the province, including the Invermere TSA. They have also submitted an Interim Measures Proposal that encompasses the guide and outfitting tenure areas and trap line areas registered to Columbia Lake Band members.

Both Traditional Use mapping and Archeology Overview Assessment mapping have been completed in the TSA and are being used to help protect cultural resources. In addition, a number of Archaeological Impact Assessments have been completed to identify sites of archaeological significance and develop strategies to protect them.

It is recognized that ongoing treaty negotiations with First Nations have the potential to impact timber supply in the TSA. However, "current management" was the underlying assumption for the analysis and no settlement has yet been reached. The final results from treaty negotiations will be modeled in subsequent timber supply reviews when this information becomes available. This Timber Supply Review does not limit, and is not intended to limit ongoing Treaty negotiations between the Ktunaxa Kinbasket Treaty Council, British Columbia and Canada.

2.2 The Environment

The Invermere TSA contains six biogeoclimatic zones, an indication of the climatic and biological diversity in this area. Refer to Figure 2 for an area breakdown.

The Ponderosa Pine (PP) zone occurs at low elevations (700 to 900 m) in the southern portion of the Rocky Mountain Trench. Summers in this zone are hot and dry resulting in large moisture deficits during the growing season. Winters are cool with light snow cover. Forests are dominated by ponderosa pine, and historically tended to be open and park-like with an understory of grasses. Douglas-fir, trembling aspen and birch also occur on moister sites. Over the last 70 years, fires have been excluded from these areas due to suppression activities and fine fuel reduction by cattle grazing. Consequently, these areas are increasingly characterized by a dense understory of immature and regenerating ponderosa pine and Douglas-fir.

The Interior Douglas-fir (IDF) zone also occurs in the Rocky Mountain Trench, generally between the Ponderosa Pine Zone and the Montane Spruce Zone (between 800 and 1200 m). The IDF is characterized by warm, dry summers, a fairly long growing season and cool winters. Moisture deficits are common during the growing season. Douglas-fir is the climax tree species in this zone, and historically, widespread fires created transitional woodlands and open grasslands. Other species include ponderosa pine at lower elevations; western larch and lodgepole pine at higher elevations; and cottonwood, spruce and aspen on moister sites such as floodplains. As in the Ponderosa Pine Zone, these areas are increasingly characterized by a dense understory of immature and regenerating Douglas-fir.

The Montane Spruce (MS) zone is found at mid-elevations, often between the Interior Douglas-fir Zone and the Engelmann Spruce-Subalpine Fir Zone (between 1200 and 1600 m). This zone is characterized by cold winters and moderately short, warm summers. Moisture deficits can occur during the growing season. Although subalpine fir and varieties of spruce are the dominant, climax tree species, one of the most distinctive features of this zone is the extensive even-aged stands of lodgepole pine that have formed following wildfire. Other common species found in this zone are Douglas-fir, western larch, western redcedar, trembling aspen and cottonwood.

The Interior Cedar-Hemlock (ICH) zone occurs at low to middle elevations (700 to 1500 m) in the wetter portions of the Purcell and Rocky Mountains. This zone has a climate dominated by easterly moving air masses that produce cool wet winters and warm dry summers. Snow melt minimizes soil moisture deficits in the summer. This is the most productive zone in the interior of B.C. and also has the highest diversity of tree species of any zone in the province. Western redcedar, western hemlock and hybrid white spruce dominate the rare climax forests that occur in the Invermere TSA. Other species are Douglas-fir, lodgepole pine, white pine, western larch, ponderosa pine, birch, trembling aspen and cottonwood.

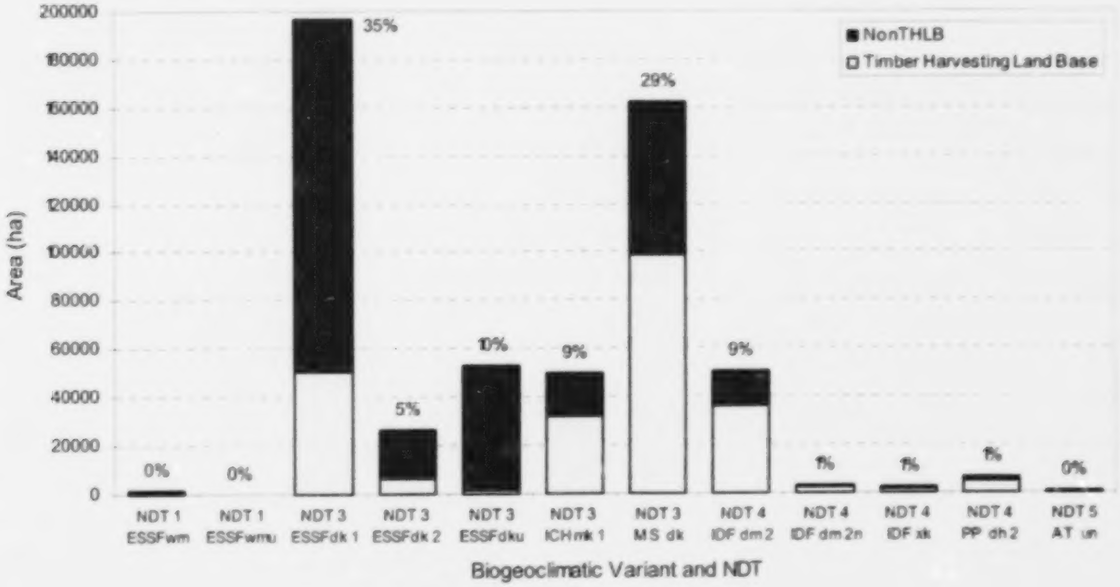

Figure 2. Biogeoclimatic Ecocsystem Classification Area Summary

The Engelmann Spruce-Subalpine Fir (ESSF) zone is the uppermost forested zone, lying below the Alpine Tundra from 1600 to 2000 m. Growing seasons are cool and short while winters are long and cold. Forests are continuous at the lower elevations of this zone, but at higher elevations clumps of trees occur within areas of heath, meadow and grassland. Engelmann spruce and subalpine fir are the dominant climax tree species, but whitebark pine, lodgepole pine, alpine larch and trembling aspen are also common.

The Alpine Tundra Zone lies above the Engelmann Spruce-Subalpine Fir Zone, and is by definition treeless although stunted (or krummholz) trees are common at the lower elevations of this zone. Overall, this zone is dominated by rock, ice and grassy meadows.

The Invermere TSA is part of the East Kootenay region, which is unique in North America for its density and diversity of wild ungulate and large predator populations. Other large mammals, small mammals and birds are also abundant in the TSA. This wealth of wildlife is made possible by the great variety of habitat types available in the area. The valley floor of the Rocky Mountain Trench offers high quality ungulate habitat due to its limited snowfall and low elevation (800 m above sea level). Ungulate species include elk, mule deer, whitetail deer, moose, Rocky Mountain bighorn sheep, mountain goat, and caribou. Other large mammals include mountain lions, wolves, coyotes, black bear, and grizzly bear. Small furbearers include beaver, mink, muskrat, otter, fisher, marten, skunk, weasel, badger, wolverine, bobcat, lynx, squirrel, fox, and raccoon.

This region also supports 70% of the bird species known to occur in BC and 62% of all the bird species that breed in the province. The Columbia Wetlands is an important habitat for nesting and migration of numerous species. The lakes and streams of the TSA also provide valuable bird habitat while supporting a wide range of fish species, including bull trout (Dolly Varden), cutthroat trout, rainbow trout, eastern brook trout, kokanee, mountain whitefish, burbot, walleye, and smallmouth bass.

There are wildlife species in the TSA which are at risk due to declining populations across the province. There are 8 red-listed (Endangered or Threatened) and 18 blue-listed (Species of Concern) species found in the Invermere TSA (Table 2). Since TSR2, the Vivid Dancer (damselfly), and the fisher have been red-listed, while the Mead's Sulphur (butterfly) and cutthroat trout have been blue-listed. The rubber boa, blue-listed at the time of TSR2, is now yellow-listed and the Rocky Mountain bighorn sheep has been removed from the blue-list.

Table 2 . Red and Blue Listed Species with Potential to Occur in TSA

Red-listed (Endangered or Threatened)		**Blue-listed (Species of Concern)**	
Scientific Name	English Name	Scientific Name	English Name
Argia vivida	Vivid Dancer	*Acrocheilus alutaceus*	Chiselmouth
Buteo swainsoni	Swainson's Hawk	*Aeronautes saxatalis*	White-throated Swift
Falco mexicanus	Prairie Falcon	*Ardea herodias herodias*	Great Blue heron, *herodias* subspecies
Martes pennanti	Fisher	*Asio flammeus*	Short-eared Owl
Rana pipiens	Northern Leopard Frog	*Botaurus lentiginosus*	American Bittern
Rangifer tarandus pop. 1	Caribou (southern population)	*Chrysemys picta*	Painted Turtle
Tamias minimus selkirki	Least Chipmunk, *selkirki* subspecies	*Colias meadii*	Mead's Sulphur
Taxidea taxus	Badger	*Dolichonyx oryzivorus*	Bobolink
		Grus canadensis	Sandhill Crane
		Gulo gulo luscus	Wolverine, *luscus* subspecies
		Melanerpes lewis	Lewis's Woodpecker
		Myotis septentrionalis	Northern Long-eared Myotis
		Numenius americanus	Long-billed Curlew
		Oncorhynchus clarki lewisi	Cutthroat Trout, *lewisi* subspecies
		Otus flammeolus	Flammulated Owl
		Salvelinus confluentus	Bull Trout
		Tympanuchus phasianellus columbianus	Sharp-tailed Grouse, *columbianus* subspecies
		Ursus arctos	Grizzly Bear

Source: Conservation Data Center database query, March 2004.

2.3 Integrated Resource Management Considerations

Integrated resource management is a basic premise for the practice of forestry in the Invermere TSA. Timber harvesting is planned and managed is such a way that allows a wide range of other values to co-exist on the land base. The manner in which each value is considered is dictated by federal or provincial legislation or BC government policy. Examples of these are the federal Fisheries Act, the Forest Practices Code, the Kootenay Boundary Higher Level Plan Order, the Kootenay Boundary Land Use Plan Implementation Strategy, and the Rocky Mountain Forest District Policy on Scenic Area management.

These documents address requirements for a wide range of non-timber issues. The most significant issues influencing forest management in the Invermere TSA are:

- Biodiversity
- Riparian Habitat
- Domestic and Community Watersheds
- Fire Maintained Ecosystems
- Ungulate Winter Range
- Grizzly Bear
- Caribou
- Identified Wildlife (Goshawk, Bull trout, Lewis woodpecker, etc)
- Viewscapes in Scenic Corridors
- Forest Recreation

The areas affected by each of these non-timber resource values and the specific forest management practices required to address them are discussed in Section 3.3.1.

2.4 Current Attributes of the Invermere TSA

This section of the document describes the current state of the Invermere TSA and provides descriptions and statistics useful for understanding the timber supply analyses presented later in the document. The Timber Harvesting Land Base (THLB) and Crown Forested Land Base (CFLB) referenced in this section are defined in detail in Section 3.1.

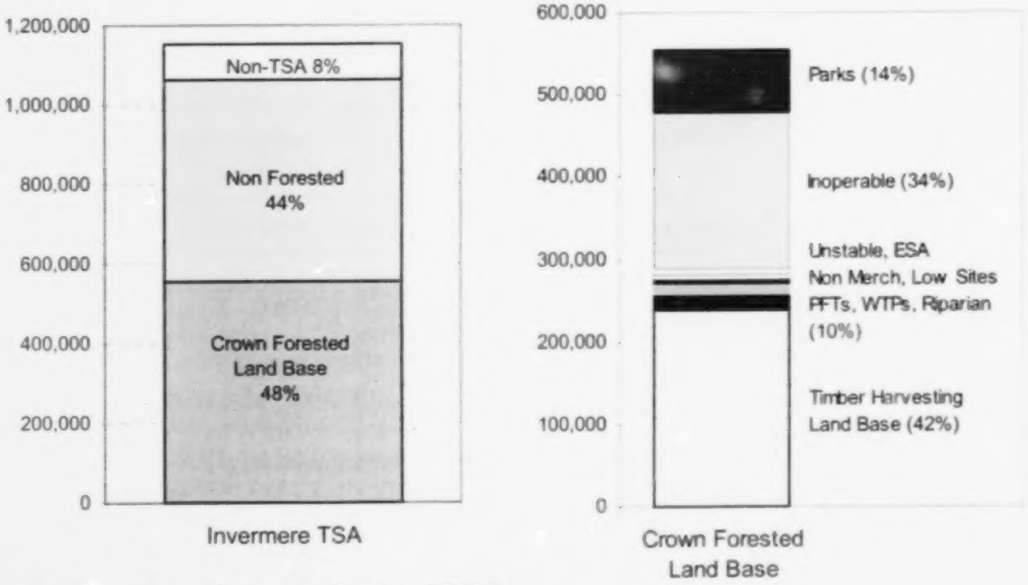

Figure 3. Land Base Summary: Total and CFLB

Approximately 48% of the total area of the Invermere TSA is considered Crown Forested Land Base (CFLB). The remaining 52% is considered non productive (i.e. rock, ice, alpine, etc), or is not managed by the B.C. Forest Service (i.e. private, First Nations, woodlots, etc). Within the CFLB, only about 42% is considered available for timber harvesting (20% of the total TSA). Refer to Figure 3.

A coarse map illustrating the locations of the CFLB and THLB is shown below (Figure 4).

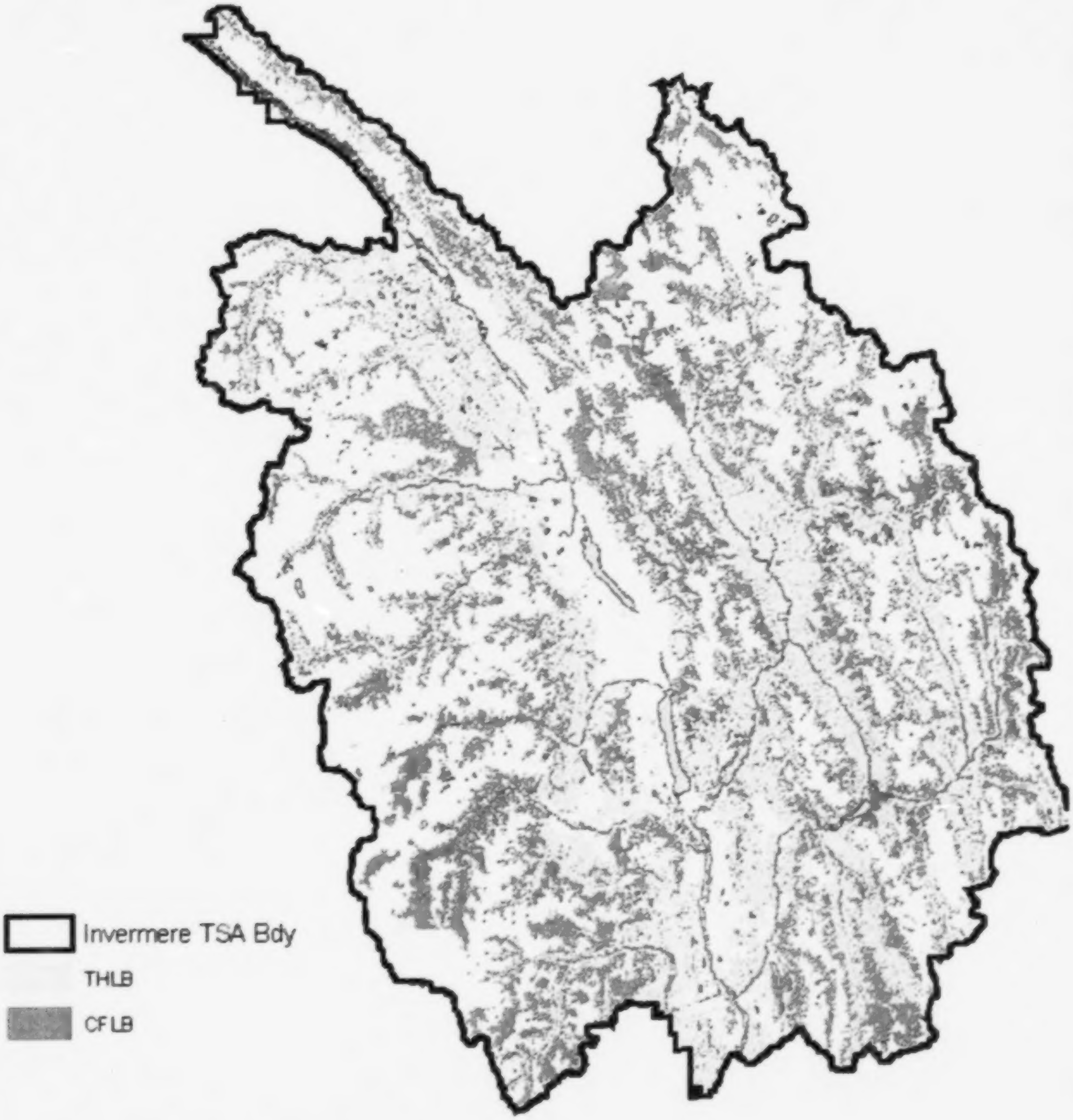

Figure 4. Land Base Classification Map

The forests of the Invermere TSA are dominated by lodgepole pine (40.7%), Douglas-fir, Engelmann spruce, larch and subalpine fir or balsam (Figure 6). Other tree species that occur less commonly in the TSA include ponderosa pine, western hemlock, western red cedar, whitebark pine, cottonwood, birch and aspen. Figure 6 indicates that approximately 39% of the THLB is currently older than the minimum harvest ages defined in this document and Figure 7 indicates that over 50% of the THLB is currently older than 80 years of age.

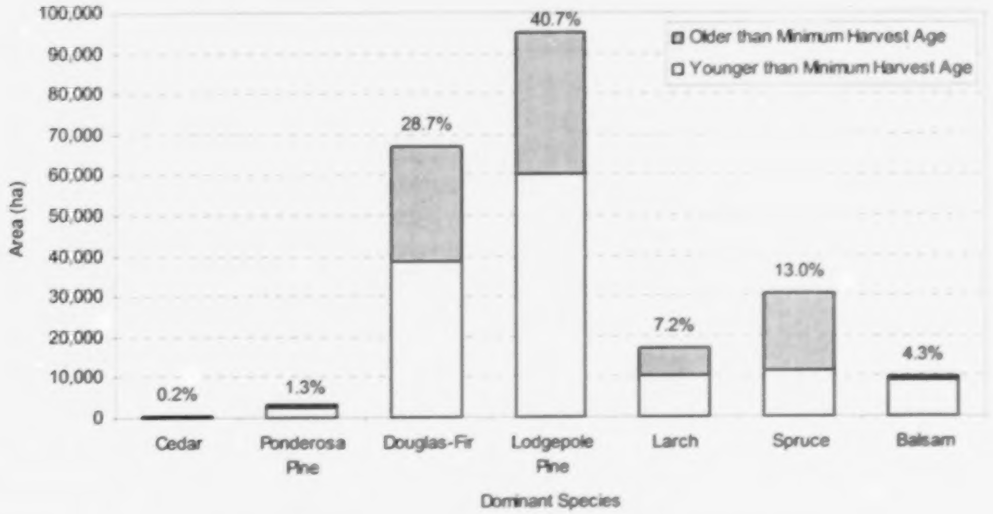

Figure 6. THLB area by dominant tree species relative to minimum harvest age

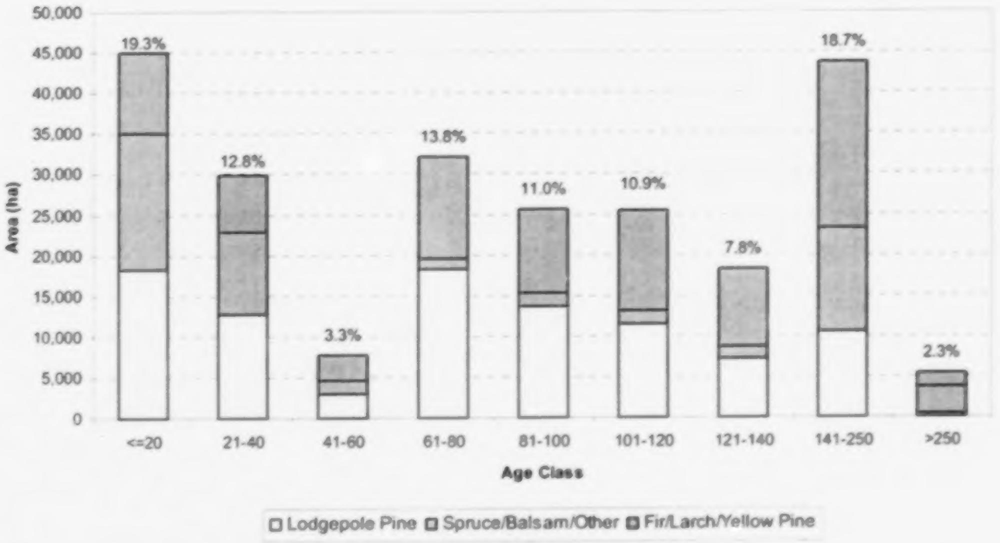

Figure 7. THLB area by age class and leading species

As indicated by Figure 7, the TSA has a significant amount of mature lodgepole pine leading stands. There are approximately 60,000 ha of lodgepole pine over 60 years old on the THLB (26% of THLB) and the portion of this area outside the ESSF ecosystems is considered susceptible to attack by mountain pine beetle.

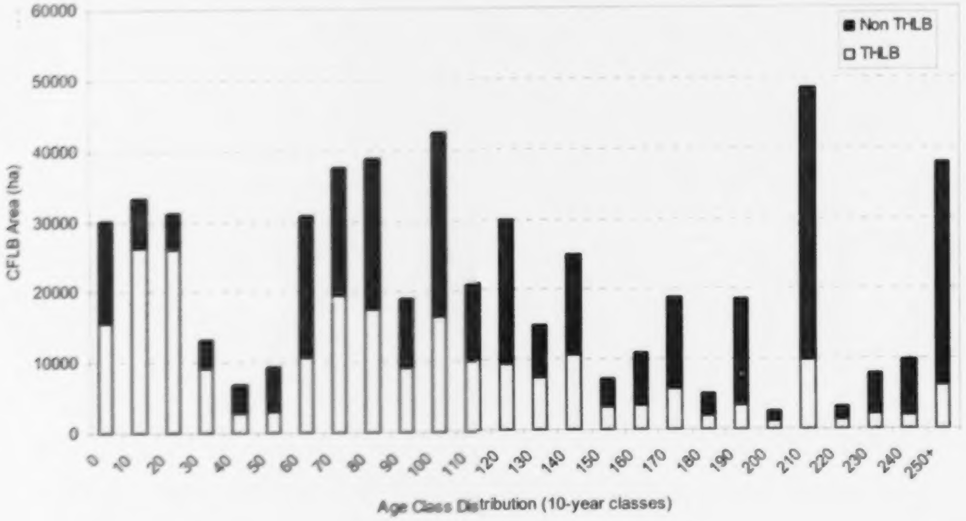

Figure 8 . CFLB area by Age Class

The age class structure over the entire CFLB is shown in Figure 8. Area is well distributed over a wide range of age classes, with most area falling within the 0-20, 80-140, 210, and greater than 250 age classes. The spike of area at 210 years is likely an artifact of midpointing older ages during forest cover typing. The younger age classes (<30 yrs) have a high % of THLB within them because the predominate method of creating young stands in recent years has been forest harvesting. The exceptions to this are the large fires of 1985 and 2003. These fires moved significant areas of both THLB and non-THLB into younger age classes.

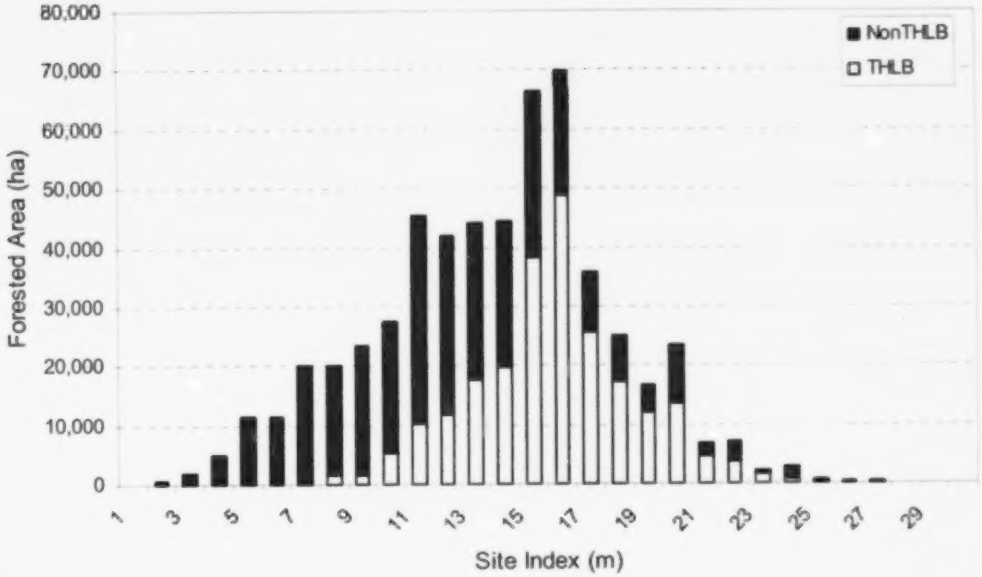

Figure 9 . Site Productivity by Landbase Type (Existing Inventory Estimates)

A summary of area by site productivity as indicated by existing inventory estimates is shown in Figure 9 and indicates that the THLB area is heavily skewed toward the portion of the land base with higher site indexes. As per the low site index netdown criteria listed in Appendix B, no THLB area occurs where site index is less than 8 and only small portions of site indexes 8-13 are included in the THLB. The average site index in the THLB is 15.7m and the average site index in the CFLB is 13.6m.

The average site index for all future managed stands on the THLB was calculated as 18.2m using the SIBEC site index adjustment process (see Appendix B – Section 4.1.2). This is 2.5m or 15.9% higher than the current inventory estimate.

3.0 Timber Supply Analysis Methods

A large amount of information is required to complete a timber supply analysis. Information must be obtained in four broad categories: land base, forest inventory, management practices, and forest dynamics. This information is then translated into a model formulation that can explore sustainable rates of harvest in the context of integrated resource management. This section summarizes the data inputs, assumptions, and modeling procedures contained in Appendix B.

3.1 Land Base Definition

The crown forested land base (CFLB) is the area of productive forest under provincial crown ownership. This is the total area of land base that contributes to landscape level objectives for biodiversity and resource management. The crown forested land base excludes non-crown land, woodlots, non-forest and non-productive areas. For the purpose of this analysis, it includes Kootenay National Park (See Appendix B – Section 2.3.1).

The timber harvesting land base (THLB) is the portion of the management unit where forest licensees under license to the province of BC are expected to harvest timber. The THLB is a subset of the crown forested land base and excludes areas that are inoperable or uneconomic for timber harvesting, or are otherwise off-limits to timber harvesting. Table 3 summarizes the land base for the Invermere TSA. A more detailed description of netdown areas can be found in Appendix B, Section 2.0.

Comparisons with TSR2 area netdowns are difficult because a different netdown hierarchy was used, but several key differences are discussed below:

- Total TSA area in TSR3 is larger by approximately 40,000 ha because of the inclusion of Kootenay National Park. TSR2 did not include this park in the gross area of the TSA.
- A TSR2 equivalent to the CFLB area in TSR3 is not available – all park ownership was removed with private land as the first TSR2 netdown. As this netdown included both forested and non-forested area, it is impossible to recreate a TSR2 CFLB area.
- The size of the THLB in TSR3 appears to be smaller than TSR2 by 7886 ha (3.3%) for a number of reasons detailed in Section 3.6 of this document. The effective difference between the two land bases is actually smaller than this because TSR2 reduced volume curves to account for some factors addressed spatially through netdowns in TSR3 (existing WTP's, existing trails/landings). Both approaches would ultimately have had similar impacts on projected timber supply. The reasons behind the smaller THLB in TSR3 appear to be the removal of NP-Backlog areas, reduced operable area, removal of the Findlay corridor and isolated drainage, more problem forest type area, more riparian area, removal of WTPs and existing trails and landings. These reductions were partially offset by fewer hectares removed for unstable terrain (TSR3 used terrain mapping in place of ESA soils mapping).

The TSR3 *long term* THLB is significantly smaller (10.9%) than the reported TSR2 area. The difference can be partly explained by the TSR3 approach of excluding additional categories of land (future WTR, Open Range) beyond just future roads. TSR2 also reduced timber supply for these factors but chose not to reflect them in the long-term THLB area. For future roads, the TSR2 and TSR3 estimates are also quite different – again, part of the difference appears to be the inclusion of trails and landings in TSR3 but the TSR2 number still appears low.

Table 3. Land Base Area Netdown Summary

Factor	Total area (ha)	Effective Area (ha)*	% of Forest District	% of Crown forest
Total TSA (old Invermere Forest District less TFL14)	1,153,073	1,153,073	100%	
Less:				
Private Land, First Nation reserves	74,034	74,034	6.4%	
Woodlots, X-mas tree permits, Misc Leases	16,264	16,264	1.4%	
Total TSA under Crown Ownership	1,062,775	1,062,775		
Non-forest / Non-productive forest	520,970	496,284	43.0%	
Non-Commercial Brush	146	146	0.0%	
Backlog NSR (non-productive stands)	971	936	0.1%	
Unclassified existing roads, trails and landings	17,573	10,759	0.9%	
Total Crown Forested Land Base (CFLB)**		554,650	48.1%	100%
Less:	In CFLB:			
Fed Parks, Prov Parks and Reserves	232,340	77,666	6.7%	14.0%
Inoperable/Inaccessible	254,162	183,861	15.9%	33.1%
Operable/Inaccessible (Slope > 70%)	4,320	4,296	0.4%	0.8%
Unstable Terrain	32,307	6,893	0.6%	1.2%
Environmentally Sensitive Areas (includes Es where terrain mapping does not exist)	82,151	6,723	0.6%	1.2%
Non-Merchantable	24,810	5,335	0.5%	1.0%
Low Sites	100,611	11,643	1.0%	2.1%
Problem Forest Types	9,828	6,024	0.5%	1.1%
Riparian Management Areas	31,415	17,669	1.5%	3.2%
Existing Wildlife Tree Patches	844	637	0.1%	0.1%
Timber Harvesting Land Base –THLB (ha)		233,873	20.3%	42.2%
Volume Reductions:				
Identified Wildlife Management Strategy	0%	0		
Future Wildlife Tree Retn and other Retn (%)	3.5%	8,186		
Other Future Reductions:				
FMER Open Range		1,585		
Future roads, trails and landings		11,016		
Long-term Timber Harvesting Land Base (ha)		213,087		

* Effective netdown area represents the area that was actually removed as a result of a given factor. Removals are applied in the order shown above, thus areas removed lower on the list do not contain areas that overlap with factors that occur higher on the list. For example, the unstable terrain netdown only removes area from the crown, operable forested land base.

** Crown forest in this context denotes the forest area that contributes to forest management objectives, such as landscape-level biodiversity, wildlife habitat and visual quality. It does not include alpine forest or non-productive areas with trees species.

3.2 Forest Inventory Data

Understanding and representing the current state of the forests in the TSA is a key component of the timber supply review. The digital forest cover inventory files provide this data (species, age, height, site productivity, etc). A history of the Invermere forest cover data is summarized briefly below:

- The most recent forest cover inventory for the TSA was completed in 1995. Since then, the forest cover has been updated for disturbances to December 2000, except for the 82F/82J mapsheets that have been updated to December 2001. Logged block information compiled by licensees was used to further update disturbances to Jan 2003 in the TSR3 digital file.
- The forest cover attributes have been projected to January 1, 2003.

- An audit of the inventory was completed in 1996 and showed that natural stands contained 3.4% more volume than was predicted by the inventory, though the difference was not deemed statistically significant.
- The volumes associated with partially harvested stands within the inventory (history record shows a % logging history) have been adjusted to account for over-prediction of volumes by VDYP. VDYP does not accurately reflect volume removal in partially harvested stands, so a manual adjustment to the volumes, to reduce them by the area disturbed, has been performed on these stands. (Refer to Appendix B – Section 4.5 for more detail.)

3.3 Management Practices

Management practice assumptions can be grouped into three broad categories: Integerated Resource Management, Silviculture, and Harvesting.

3.3.1 Integrated Resource Management

In order to accommodate the range of timber and non-timber resource objectives that occur within the TSA, forest cover requirements were applied within the timber supply model. These requirements limit disturbance or maintain appropriate levels of specific forest types that are needed to satisfy objectives for wildlife habitat, visual quality, biological diversity, etc. The type of objectives modeled and the size of the land base affected by each objective is summarized in Figure 10 and Table 4. The specific forest cover requirements modeled for each objective are provided in Appendix B – Section 7.0.

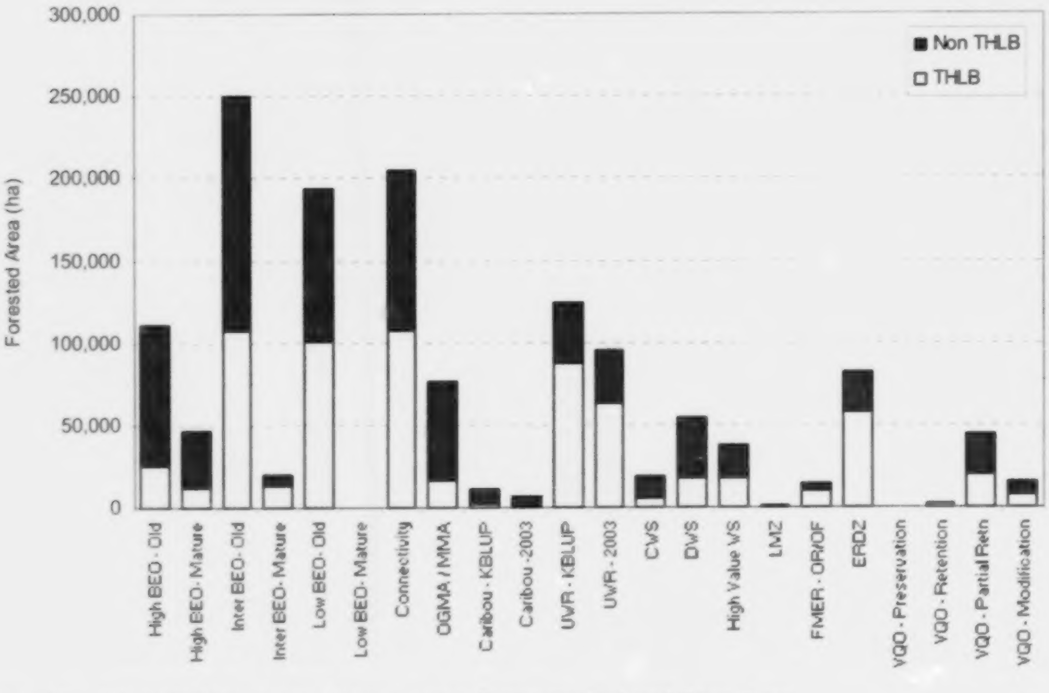

Figure 10. Integrated Resource Values: Area Summary by Land Base Type

A summary of the areas over which various non-timber resource values occur is provided in Table 4. These areas cannot be summed to determine the total area affected because many of the values overlap on the land base. Approximately 109,400 ha or 47% of the THLB falls outside of all areas where non timber resource constraints are applied in the model (i.e. outside spatial OGMAs/MMA's, UWR, Caribou, CWS, DWS, Lussier watershed, LMZ's, Open Range, Open Forest, and VQO polygons).

Table 4. Integrated Resource Values: Area Summary by Land Base Type

Name	CFLB (ha)	THLB	Non THLB	% of Total CFLB	% of Total THLB	Description
High BEO - Old	110,280	25,277	85,003	19.9%	10.8%	Biodiversity Emphasis Options define the amount of old and/or mature that must be retained in each LU/BEC variant combination.
High BEO- Mature	46,012	12,251	33,761	8.3%	5.2%	
Inter BEO- Old	250,519	107,644	142,874	45.2%	46.0%	
Inter BEO- Mature	19,554	13,613	5,942	3.5%	5.8%	
Low BEO- Old	193,851	100,952	92,899	35.0%	43.2%	
Low BEO- Mature	0	0	0	0.0%	0.0%	
Connectivity	205,329	107,510	97,819	37.0%	46.0%	
OGMA / MMA	76,863	16,288	60,576	13.9%	7.0%	Area of Spatial OGMA/MMA.
Caribou - KBLUP	11,095	2,534	8,562	2.0%	1.1%	Caribou habitat areas in base case.
Caribou -2003	6,664	1,225	5,440	1.2%	0.5%	New caribou habitat area in Sensativity
UWR - KBLUP	124,281	87,351	36,930	22.4%	37.3%	Ungulate winter range in base case.
UWR - 2003	94,919	63,350	31,570	17.1%	27.1%	New ungulate winter range (sensitivity)
Community Watershed	19,263	5,218	14,045	3.5%	2.2%	(CWS)
Domestic Watershed	53,834	17,816	36,018	9.7%	7.6%	(DWS)
High Value Watershed	37,468	17,593	19,875	6.8%	7.5%	Lussier Watershed
Lakeshore Mgmt Zones	1,632	366	1,266	0.3%	0.2%	200m around L1 lakes
Fire Maintained Ecosystem Restoration	14,759	10,105	4,654	2.7%	4.3%	Open Range/Forest restoration areas.
VQO – Preservation	380	5	375	0.1%	0.0%	Visual Quality Objectives
VQO - Retention	2,726	1,844	882	0.5%	0.8%	
VQO - Partial Retention	44,176	20,084	24,092	8.0%	8.6%	
VQO - Modification	15,459	8,042	7,417	2.8%	3.4%	
Enhanced Resource Development Zone	82,327	57,523	24,803	14.8%	24.6%	Defined spatially by HLPO – based on older THLB definition.

3.3.2 Silviculture

Historical and current silvicultural practices in the TSA have been included in the model. These include:

1. Silvicultural systems (clearcut vs partial cutting systems),
2. Regeneration assumptions such as establishment method (plant vs natural), species distribution, and establishment density,
3. Regeneration delay (time between harvesting and when the site becomes stocked with crop trees)
4. Use of select seed, and
5. Treatment of Backlog and current Not Satisfactorily Restocked (NSR) stands.

TSR2 assumed a significant area of the land base was being managed under partial cutting regimes. This current analysis recognizes that far less partial cutting is currently occurring in the TSA because of the silvicultural challenges and timber supply implications it presents. All harvesting outside the Open Forest and Open Range restoration areas were modeled as clearcut with reserves or short term shelterwood systems. It is recognized that many blocks have mature trees retained in clumps, patches or as scattered stems to meet various management objectives. An in-block retention study[2] was completed in 2004 to provide an estimate of the amount of volume being left across the area modeled as 'clearcut' so that a volume reduction factor could be applied to address this variation on partial cutting in TSR3.

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[2] Invermere TSA In-Block Retention Study, March 19, 2004, Forsite Consultants

3.3.3 Timber Harvesting

Assumptions around timber harvesting practices have also been included in the model and include:

- Minimum harvest ages that ensure a viable log is produced and long term volume production is maximized. (Appendix B – Section 8.1)
- Minimum economic criteria for log size and stand volumes (Appendix B – Section 8.1).
- Harvest priorities across the land base. For example, stands burnt in 2003 are salvage logged prior to the cutting of green timber. (Appendix B – Section 8.4)
- Land base definition criteria (unstable slopes, inoperable areas, low sites, etc.). These assumptions are outlined in detail in Appendix B- Section 2.0.

3.4 Forest Dynamics

Forest dynamics refers to the changing state of the forest through time. Changes occur as it ages or grows and when natural or human caused disturbances occur. The way in which the model addresses these issues is described below.

3.4.1 Growth and Yield Projections

Timber growth and yield refers to the prediction of the growth and development of forest stands over time and the associated volume yields that would occur with harvesting. For modeling purposes, stands of similar characteristics, growth rates, and management are grouped together into Analysis Units (AUs). Analysis Units are described in Appendix B – Section 3.2. The attributes of each AU are input into growth and yield models to predict gross and net volume per hectare at various stand ages. The estimate of net timber volume in a stand assumes a specific utilization level, or set of dimensions, that establishes the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters near the base and the top of a tree.

Two growth and yield models were used to estimate timber volumes for the Invermere TSA analysis. The Variable Density Yield Prediction (VDYP) model supported by the Ministry of Sustainable Resource Management, Terrestrial Information Branch, was used for estimating timber volumes for all existing natural stands and all coniferous stands that will be harvested in the future by partial harvesting. The table interpolation program for stand yields (TIPSY), developed by the B.C. Forest Service, Research Branch was used to estimate timber volumes for both existing and future managed stands. Existing managed stands are those that are currently under 20 years of age, or older stands that have a history of planting and/or density control practices. Future managed stands are stands that will regenerate after they are harvested by the model during the planning horizon (excluding partial cut stands).

Based on timber volume estimates, the current timber inventory or growing stock on the timber harvesting land base is approximately 30.8 million cubic meters. Approximately 73% of this growing stock (22.6 million m^3) is currently merchantable (i.e. in stands older than their minimum harvest age).

3.4.2 Disturbances

The timber supply model relies upon three mechanisms to disturb stands. Harvesting is the most common method of disturbance in the model (clearcut or partial cutting) and occurs only within the timber harvesting land base. In order to recognize that natural disturbances are also occuring on the land base, the following are also modeled:

Natural disturbances in the timber harvesting land base:

Each year timber volume is damaged or killed on the THLB and not salvaged or accounted for by other factors. These losses are due to a number of factors that cause tree mortality, including insects, disease, blowdown, snowpress, wildfires, etc. In order to address losses from catastrophic natural events in the THLB, the model 'harvests' an extra volume of timber in each time period that is not counted toward harvest levels. Endemic pest losses are dealt with through factors applied in the growth and yield models. The annual unsalvaged loss applied in this analysis was 24,327 m^3/yr. See Appendix B- Section 6.0 for more detail.

Unsalvaged loss estimates address the loss of merchantable volume from mature stands. Losses associated with immature stands also impact the rate at which timber becomes available in the TSA but little data is available to estimate the extent or impact of these losses. These disturbances will be captured during periodic inventory updates and are therefore reflected in subsequent TSRs. Immature stands in the 2003 fires were addressed specifically by assuming they were dead at time zero.

Natural disturbances outside the timber harvesting land base:

Because stands outside of the THLB contribute toward several forest cover objectives (i.e. landscape level biodiversity), it is important that the age class distributions in these stands are modeled to remain consistent with natural processes. By simulating natural disturbance in these stands, a natural age class distribution can be maintained in the model and a realistic contribution toward seral goals ensured. An area of 1252 ha is disturbed each year in the analysis to prevent age classes in the NonTHLB from becoming unrealistically old during modeling. (Appendix B – Section 7.5.1)

The 2003 fires have been addressed separately in the model. All stands within the fire boundaries are assumed to be dead at time zero. If these stands were not harvested within 3 years, their volume was assumed to be lost. (Appendix B – Section 6.1)

3.5 Timber Supply Analysis Methods

The Forest Service Simulator (FSSIM) version 3.2 was used to complete this timber supply analysis. FSSIM was developed by the Ministry of Forests Forest Analysis Branch and has been used continuously in the province for many years. It is a well-documented and well-understood model that is designed to work well with BC's forestry policy and practices. FSSIM is a spatially-implicit model that allows for the modeling of constraints and harvesting with the ability to group and define forest units (classes) with geographic or ecological similarities. FSSIM can be as detailed or as generalized as required to meet the needs of the modeling objectives. FSSIM is a simulation model that permits the exploration of individual factors affecting harvest flow as well as allowed for complete control over these factors. It provides results that are realistic, tangible, and repeatable.

Similar to other models, FSSIM assumes that trees grow according to provided yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. FSSIM also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of green-up and old-forest requirements. For example, guidelines might specify that no more than 33% of the forest can be younger than a specified green-up age, or that 10% of the forest must be in older age classes to provide wildlife habitat.

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Invermere TSA, in light of current forest management practices. Modeling assists the timber supply analyst in determining harvest flows associated with various scenario definitions. Scenarios are groups of assumptions defining the extent of the timber harvesting land base, timber volumes, and the management regimes. The dominant scenario presented in this report is the base case or current management scenario. Modeling was completed for 350 years for each scenario but only the first 250 years are presented in the report because the harvest level remains constant after that time.

The results of the analysis are an important part of the annual allowable cut determination process and aim to document future harvest flows that will not restrict future options in the TSA. **The results presented here do not define a new AAC – they are intended only to provide insight into the likely future timber supply of the Invermere TSA.** The final harvest level decision will be made by the Chief Forester and published along with his rationale in an AAC Determination document.

3.6 Major Changes from Previous Timber Supply Review (TSR2)

Since the last timber supply review for the Invermere TSA (TSR2), changes have occurred in input data sets and management assumptions. In summary, the major changes from TSR2 are:

Changes impacting the size of the THLB:

- Operable area for the TSA was reviewed in 2003 to confirm the merchantability and economic viability of forest stands in the TSA. A new operable area was identified after areas were both removed (10.1%) and added (7.4%) to the old operability line. This resulted in a gross operable area that is 2.7% less than the old operability line. The net impact on THLB is unknown and would depend on how additions and subtractions overlap with other netdowns process.
- The area known as the 'Findlay Corridor', an access corridor through the Purcell Wilderness Conservancy, has been confirmed to be off limits for land uses other than mining[3]. Removing this access corridor subsequently isolated the headwaters of the Middle Findlay, resulting in a further decrease in the operable area of 2,975 ha. (This is not reflected in the bullet above). This area was mapped as inoperable during TSR2.
- Where terrain stability mapping (Level B or Level D mapping) was complete in the TSA, it was used in place of the older Environmentally Sensitive Area (ESA) soils mapping. ESA soils mapping was used in only in a small portion of the TSA (6% of the operable CFLB).
- TSR2 removed only riparian reserves that were mapped for major water features (W / L / S1-3) using orthophotography. Riparian Management Areas (RMA's) were removed in TSR2 through a yield curve reduction (0.66% on all curves – based on 1.2% of THLB in RMA and a 55% retention factor). Riparian reserves and the effective area of management zones for all riparian classes were spatially removed in TSR3 as per Appendix B – Section 2.4.8. This resulted in significantly more TSR3 riparian netdown area.
- Low productivity site definitions have been made more detailed than was used in TSR2. The new definitions are consistent with the Cranbrook TSR2 and TSR3 analyses. At roughly the same point in the netdown sequence, TSR3 removed 5227 ha more low site index area than TSR2.
- TSR3 Problem Forest Type definitions are significantly different than those used in TSR2, but are similar to those used in TSR1. At roughly the same point in the netdown sequence, TSR3 removed 1338 ha more PFT area than TSR2.
- Backlog NSR (Not Satisfactorily Restocked) – TSR3 analysis removed 936 ha from the THLB because these areas were not likely to produce a commercial crop of trees in the future. It appears that TSR2 identified 930 ha in a similar state but it is unclear how it was address in the analysis.

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[3] Personal Communication: Tom Volkers – MSRM, Cranbrook, BC, November, 2003

- The THLB area in this analysis spatially excludes existing WTPs and existing trails/landings. TSR2 addressed these issues through yield curve reductions and thus they did not factor into the calculation of the THLB area.
- The netdown for existing trails and landings in this analysis is larger than TSR2 because the percentage area reduction was applied to a larger area at the start of the analysis. Any stand with a logging history (~102,500 ha) received the 6.5% area reduction as part of the existing road buffering exercise, whereas in TSR2, a 6.5% volume reduction was applied only to stands considered 'managed' (<31 yrs old). This meant less area was removed at time zero, and the area removed did not influence the TSR2 THLB number (as described in the bullet above).

Changes impacting management assumptions:

- The Kootenay National Park (KNP) has been included in the dataset and is considered part of the Crown Forest Land Base (CFLB). The three KNP landscape units have been merged with adjoining LU's in the TSA (Cross, Pedley, and Shuswap/Windermere). Only about two-third of the KNP area had forest cover mapping available.
- Biogeoclimatic Ecosystem Classification (BEC) mapping for the Invermere TSA was revised in 2003. This has altered the area of many BEC variants and introduced new BEC variants that had not previously existed (ESSFdk2, IDFdm2n, IDFxk). Within the Kootenay National Park, BEC mapping was not revised so the older mapping was utilized.
- Predictive Ecosystem Mapping (PEM) has been completed for the TSA (not in the KNP). Site index values have been adjusted in the base case using SIBEC relationships for the following biogeoclimatic units: ESSFdk1, ICHmk1, IDFdm2, MSdk, and PPdh2. The PEM was approved for use in the base case on these variants by Del Meidinger (MoF Research) in February 2004. Details on the PEM and SIBEC adjustment are available in Appendix B - Section 4.1.2.
- TSR3 modeled the use of select seed for Pl (0-1% gain), Sx (3-14% gain), and Lw (1-3% gain) in the base case. No select seed was modeled in the TSR2 base case.
- New Visual Quality Objectives (VQO's) were make known by the District Manager of the Rocky Mountain Forest District in August 2003 and were used in conjunction with HLPO scenic areas.
- The Higher Level Plan Order (October 26, 2002) has given legal status to Landscape Units, Biodiversity Emphasis Options with Old and Mature Retention Targets, Connectivity Corridors, Caribou Management Areas, and Scenic Corridors.
- Spatially explicit Old and Mature management areas (OGMAs/MMAs) have been generated for use in the analysis. OGMAs are modeled in all LU/BEC combinations but MMA's are only modeled in the specific LU/BEC combinations identified by the HLPO in Oct 2002. TSR2 applied mature targets in all LU/BECs.
- Ungulate winter range objectives in TSR2 were applied to the THLB and only addressed elk, white tail deer and mule deer in deep snow zones with an average constraint of 40% of THLB>121 years. TSR3 added moose to the species list and applied specific goals to each species by snow zone over the CFLB. The TSR3 approach was based on interpretation of the KBLUP-IS policy.
- Caribou habitat objectives in TSR2 were modeled equally on all caribou habitat zones; an average constraint of 30%>141 years with at least 10% of this area over 250 years was applied. The partial cutting requirement in the ESSF was not modeled. TSR3 applied constraints specific to habitat types and increased the constraint in the 'ESSF below caribou line' zone to account for partial cutting restrictions.
- In TSR2, community watersheds were modeled using a maximum 20% ECA (max 20%<6m in THLB). TSR3 modeled a maximum 30% ECA (max 30%<6m in CFLB). Domestic watershed cover constraints were not modeled in TSR2 but were modeled in TSR3 using the same objectives as community watersheds.
- TSR2 assumed a significant area of the land base was being managed under partial cutting regimes (~25% of THLB – harvest limited to 22% of cut or 46.4% of area harvested). This analysis recognizes that less partial cutting is currently occurring in the TSA because of the silvicultural and timber supply

challenges it presents. All harvesting outside the Open Forest and Open Range restoration areas were modeled as clearcut with reserves or short term shelterwood systems. However, it is recognized that many 'clearcut' blocks have mature trees retained in clumps, patches or as scattered stems to meet various management objectives. An in-block retention study[4] was completed in 2004 to provide an estimate of the amount of volume being left across the 'clearcut' AU's so that a volume reduction factor could be applied to address this type of partial cutting.

- WTP's / In-block Retention: In TSR2, WTP reductions were applied to clearcut analysis units using OAFs ranging from 0.3 - 4.3% (no average available). There was no documentation of any reductions to the partial cutting AU's - but WTP's were likely taken. For seedtree retention, TSR2 assumed that veteran trees excluded form the modelling adequately reflected volume reductions for existing stands, and then managed AU's with seedtree systems occurring had an extra 5% OAF applied. For TSR3, the in-block retention study results were used and indicated a 3.5% volume reduction be applied to all existing and managed stand volumes.

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[4] Invermere TSA In-Block Retention Study, March 19, 2004, Forsite Consultants

4.0 Base Case Analysis

The base case scenario presented in this report is based on the best information currently available and reflects current management practices in the TSA. The current allowable annual cut (AAC) for the Invermere TSA is 581,570 m^3/yr (set September 1, 2001).

Non-recoverable losses of timber in the THLB are estimated to be 24,327 m^3/yr and have already been subtracted from the graphs, tables, and harvest forecasts presented in this report.

4.1 Alternative Harvest Flow Scenarios

Numerous alternative harvest forecasts are possible for a given set of modeling assumptions (i.e. the base case defined in Section 3.0). These alternative flows represent tradeoffs between short, mid, and long term harvest level objectives. Figure 11 shows three potential harvest flows for the Invermere TSA base case assumptions.

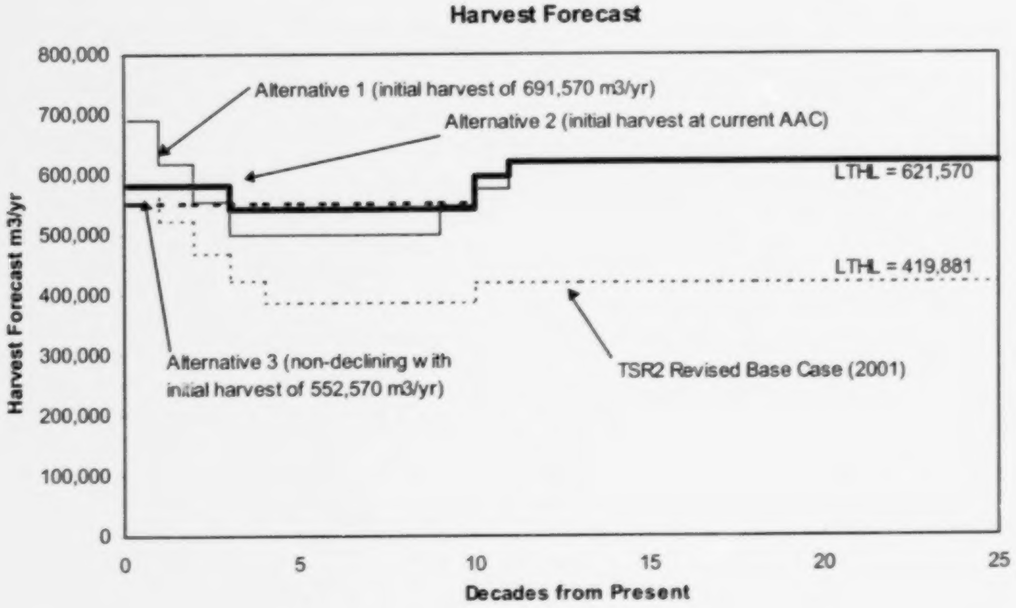

Figure 11 . Alternative harvest forecasts for the Invermere TSA, 2004

Alternative 1 illustrates a high initial harvest rate (691,570 m3/yr) that can be maintained for only one decade before declining rapidly to a low of 498,570 m3/yr in the fifth decade (28% below the initial harvest rate). The rise to the long term harvest level begins in the eleventh decade and results in a long term level of 621,570 m3/yr (6.9% above the current AAC).

Alternative 2 seeks to maintain the current AAC of 581,570 m3/yr for as long as possible, and maximize the long-term harvest level. It is able to maintain the current AAC for 30 years, before declining to a low of 542,570 m3/yr in decade four (6.7% below the current AAC). The rise to the long term harvest level begins in the eleventh decade and results in a long term level of 621,570 m3/yr (6.9% above the current AAC).

Alternative 3 is a non-declining harvest scenario where the initial harvest of 552,570 m3/yr is not allowed to drop. This harvest level is sustained for 10 decades where the rise to the long term harvest level then begins in the eleventh decade and results in a long term level of 621,570 m3/yr (6.9% above the current AAC).

For comparison reasons, the final TSR2 base case harvest forecast is also shown. This run was described in the Chief Forester's determination document because it was completed after the analysis report was published to correct an error in the modeling of partial harvesting. In this harvest forecast, the current AAC of 581,570 m3/yr was maintained for 1 decade before declining to a low of 388,880 m3/yr in the fifth decade. The rise to the long term harvest level occurs in the eleventh decade and results in a harvest level of 419,881 m3/yr (28% below the current AAC, 32% below the long term level for the three TSR3 alternatives).

4.2 Selected Base Case Harvest Flow

Alternative 2 from Figure 11 above was selected to be the base case flow and is shown in detail in Figure 12. This flow best meets the provincial policy of providing for a managed and gradual transition from short term to mid term to long term, by avoiding large and abrupt disruptions in timber supply. All of the harvest attributes and forest level attributes presented in this section correspond with this base case harvest forecast. All sensitivity analyses that follow will be compared to this base case harvest forecast.

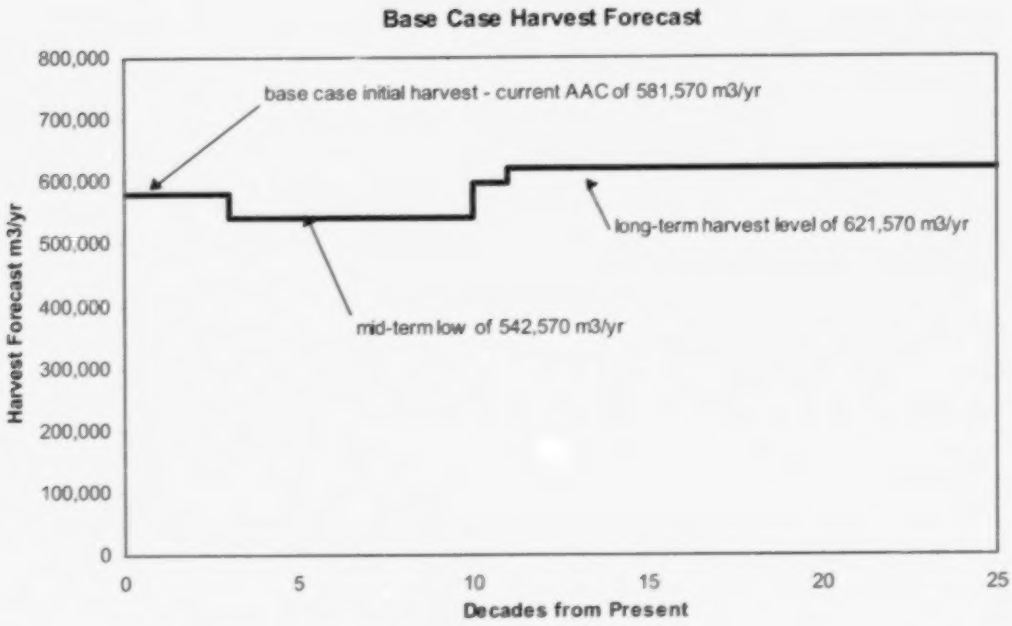

Figure 12. Base case harvest forecast, Invermere TSA, 2004

4.3 Base Case Attributes

In order to understand and evaluate the base case harvest forecast, this section describes the stands being harvested over time and the corresponding state of the forest over time. Numerous forest management assumptions have been modeled in the base case analysis, many of which impact the condition of the forest through time. Using the information presented in this section, it is possible to validate these assumptions and review their impact on the overall composition of the forest.

4.3.1 Growing Stock and Timber Availability

Figure 13 shows the total and merchantable volume of timber on the timber harvesting land base throughout the 250 planning horizon. The total growing stock is the net volume of all stands containing trees larger than specified minimum tree diameters (i.e. contain trees >12.5 or 17.5 cm dbh depending on species). The merchantable growing stock is the subset of total volume that comes from stands that are older than their specified minimum harvest age. A flat growing stock curve is desirable because it signals that the rate of harvest is roughly equal to the rate of forest growth.

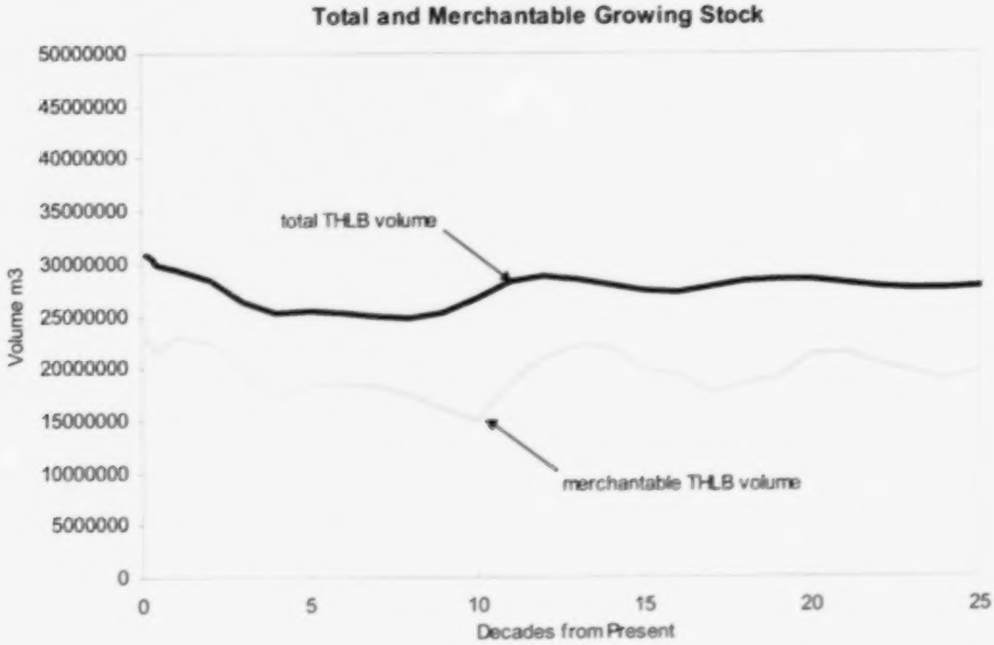

Figure 13. Merchantable and Total Growing Stock on the THLB

The total current volume on the timber harvesting land base is nearly 31 million cubic meters (Figure 13). Of this total volume, just over 22.5 million cubic meters is currently merchantable. By comparison, the published TSR2 base case total growing stock was approximately 34 million cubic meters and the merchantable growing stock was approximately 29 million cubic meters. In both cases, the TSR3 stock is lower (3 million less for total, 6.5 million less for merchantable) because harvesting over the last six years has removed mature volumes faster than young stands have come online and the size of the THLB in TSR3 is smaller.

Both total and merchantable growing stocks are low in decade 4, corresponding with the mid-term harvest reduction in the base case (Figure 12). Merchantable growing stock reaches another low point in period 10, just prior to the climb to the long term harvest level. Total growing stock is increasing over this time as managed stands begin to gain significant volume, but the corresponding increase in merchantable volume is delayed because stands must reach minimum harvest age first.

After decade 11, growing stock becomes relatively stable over the long term, meaning that the harvest of timber is roughly equal to the growth rate during this time.

Figure 14 below illustrates trends in harvest availability over time. Period 4 and 10 can be seen as the 'pinch points', or periods that defines the depth and timing of the mid term trough. These 'pinch points' have the least available timber of any period and necessitate the mid-term reduction that begins in decades 4. This availability graph does not represent a potential harvest flow - it depicts the amount of available harvest volume in each decade, assuming the base case harvest flow was followed for all prior periods (graph is built from 25 separate runs).

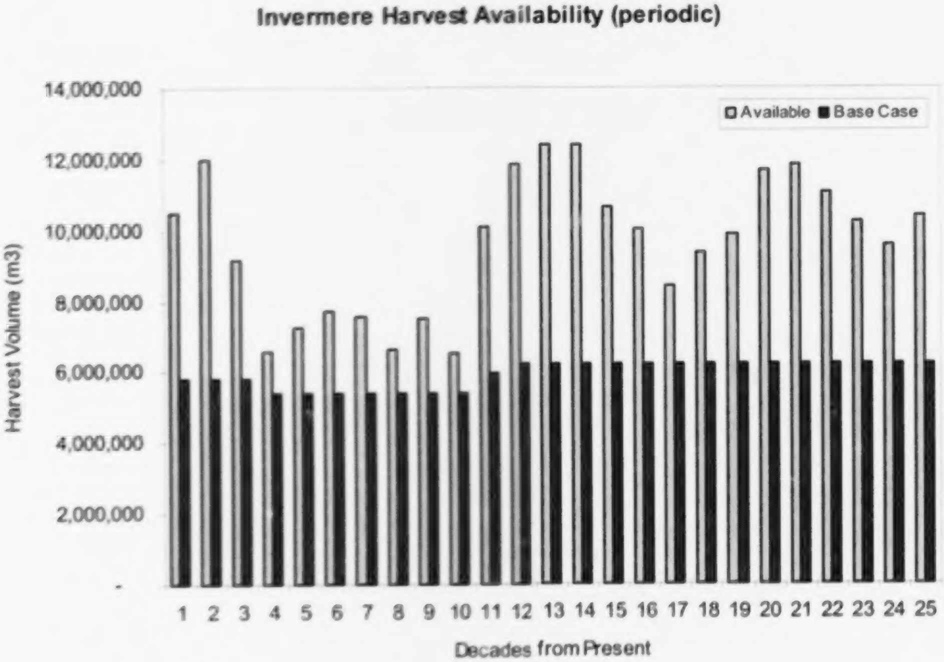

Figure 14. Periodic harvest availability, Invermere base case

4.3.2 Harvest Attributes

Figure 15 shows the contribution of both natural and managed stands to the base case harvest forecast. In the first 4 decades, the harvest of timber is almost exclusively from existing natural stands. In the 5th decade, the harvest of natural stands drops sharply as existing managed stands become available for harvest and make more than half of the harvest volume. The transition to managed stands continues rapidly until the 9th decade, where there is again a large proportion of harvest coming from natural stands. The 9th decade is when the location of old-growth and mature management areas are allowed to shift from the original spatial deployment locations to other suitable locations. This results in a spike in the amount of existing natural stands being harvested in this period. By the 11th decade, the harvest comes almost entirely from managed stands, and the base case harvest forecast transitions up to the long-term harvest level.

The base case harvest forecast has various species and stand types contributing to the overall harvest, often at different times. One means of attempting to create a 'realistic' harvest forecast, was to ensure that the harvest in the short term comes from species and analysis units currently being targeted by forest licensees. The base case model has placed a harvest priority on younger pine stands (stands <110 yrs old) for the first 5 decades of the harvest forecast. In Figure 16 below, the harvest coming from pine leading stands comprises between 50 and 65% of the harvest for the first 3 decades, until merchantable pine stands become scarcer and their contribution to the harvest drops sharply in decades 4 to 7. The high harvest of pine stands in the short term represents the current practice of targeting these stands for mountain pine beetle management and salvage harvesting. The amount of pine harvest climbs again in decade 7, corresponding with the dominance of managed stands in this period. Pine leading managed stands are the first to come online because they have the lowest minimum harvest age of any species group.

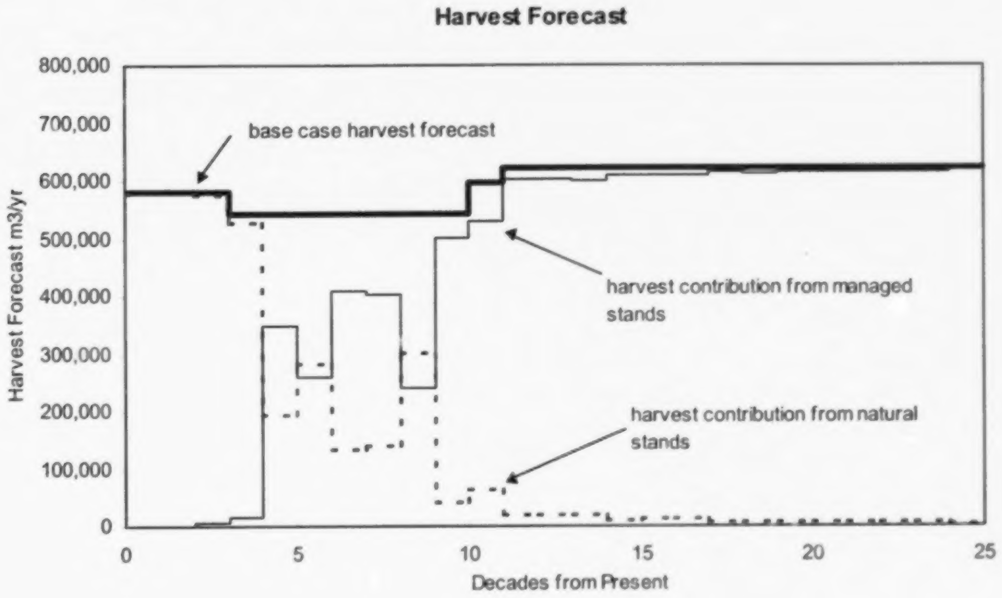

Figure 15. Transition of Natural Stands to Managed Stands

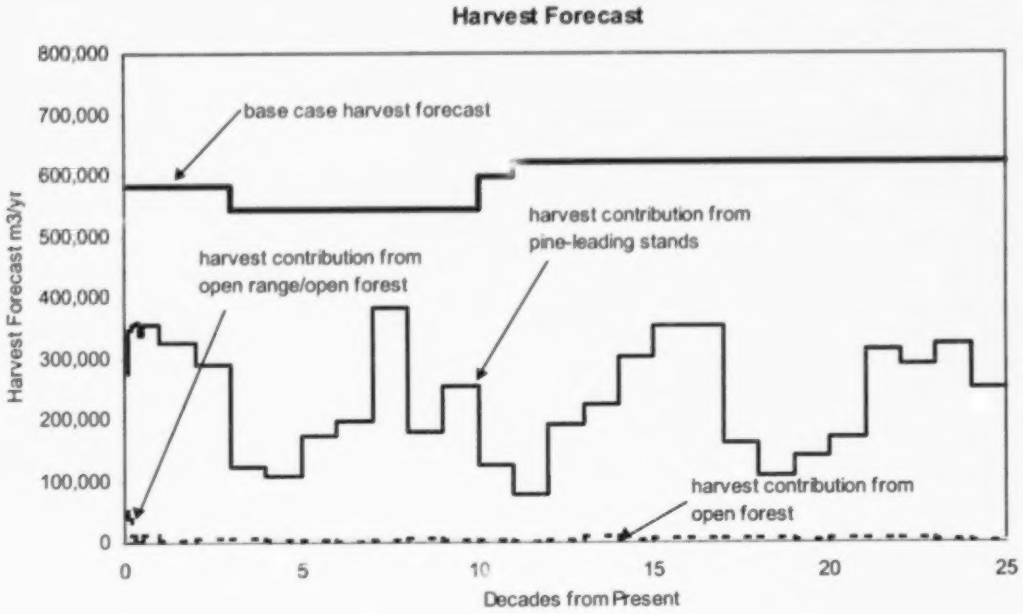

Figure 16. Contribution of pine leading stands, Open Forest and Open Range to the base case forecast

Open Forest and Open Range stands in the TSA are also being targeted by licensees to restore these ecosystems back to a more natural state. The restoration of these dry ecosystems is expected to occur over the next 27 years[5]. In the base case model, the area treated is limited to a maximum of 350 hectares per year for Open Forest and 59 hectares per year for Open Range. This ensures that their contribution to the overall harvest each year is not greater than what forest licensees are actually anticipated to harvest. Figure 16 shows that the actual volume of harvest coming from these stands is very small over the next 250 years (<5% in first decade, <1% in long term). No harvesting occurs in Open Range after decade 11 because all stands have been treated and these stands are not re-entered after restoration has taken place.

The highest harvest priority in the model was the salvage of burnt timber in the 2003 fire areas. The amount of fire salvage occurring in the model was limited to 326,000 m^3 or 1676 ha based on licensee expectations of harvest in these areas. The actual harvest achieved by the model was only 221,722 m3 on 1042 ha (avg 212 m3/ha). This is well below the salvage volume anticipated by licensees but represents all of the merchantable growing stock in the fires in the first 3 years of the harvest forecast. The model was unable to harvest additional area/volume in the fires because of minimum harvest ages, higher decay/waste/breakage, and classification of 10% of the fire as non-productive ground.

Mean harvest age provides an indicator of the type and age of stands harvested over time. The timber harvesting land base is currently dominated by older natural stands that are being replaced by younger managed stands over the next 100 years. Within this general trend, licensees have been forced to harvest significant areas of younger pine to address mountain pine beetle concerns. To ensure that the base case model was harvesting a 'realistic' profile of stand ages, a harvest priority was placed on younger pine stands.

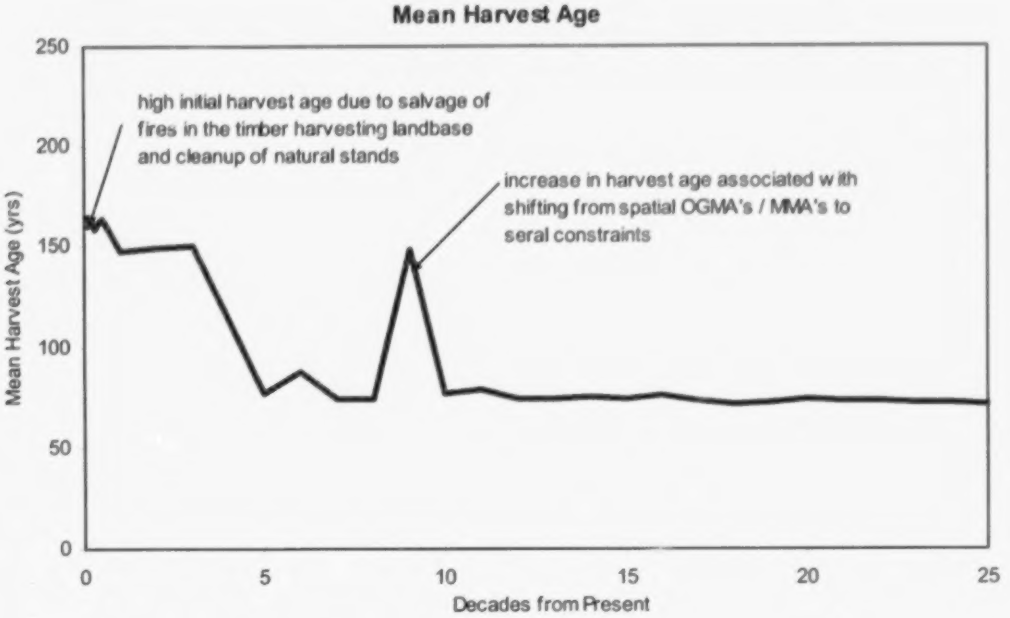

Figure 17. Mean Harvest Age - Invermere TSA base case

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[5] As per "A Blueprint for Action", Rocky Mountain Trench Ecosystem Restoration Steering Committee, Feb 2000.

Figure 17 shows the mean harvest age of the base case analysis. In the short term, mean harvest age is 150-160 years old. This high initial harvest age is primarily due to the salvage of fires (mainly the Middle Fork fire), the initial harvesting of some old Open Forest/Open Range stands, and the harvest of natural stands on the land base. The harvest age quickly drops in the fifth decade as the managed stands begin to make up a significant portion of the harvest. There is a very pronounced increase in harvest age in the 9th decade associated with the harvest of the original OGMA's and MMA's as they shift to other suitable stands on the land base. Over the planning horizon, the average harvest age is 84 years. This breaks down to a 142 yr average over the first 40 years and then a 76 yr average over the remainder of the planning horizon.

The mean harvest volume per hectare provides a sense of the types of products that may be derived from timber harvesting, and the costs associated with harvesting. Figure 18 provides the mean harvest volume/hectare over time for the base case. It starts off relatively low (~220 m3/ha) because of the amount of Open Range/Open Forest in the harvest. The vol/ha climbs as it exhausts these types of stands and begins to harvest higher volume natural stands. It then falls to its lowest level (~200 m3/ha) at the just after the pinch point in decade four as the youngest of both the natural and managed stands are harvested. By decade 10, the harvest is dominantly coming from managed stands and the mean harvest volume is increasing – averaging 238 m^3/ha from decades 10 to 25.

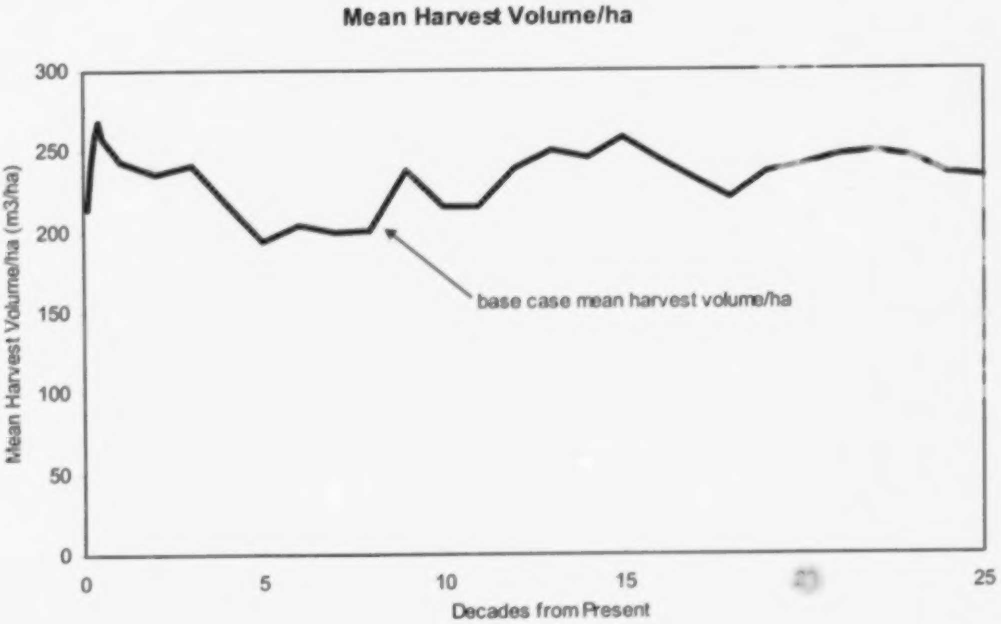

Figure 18. Mean harvest volume/ha - Invermere TSA base case

Total harvest area has a reverse relationship with harvest volume per hectare. As harvest volume goes up, the harvest area goes down, and vice versa. Figure 19 shows the total harvest area in the TSA. Harvest area is at it's greatest in the short-term, with over 2450 hectares per year harvested in decade 1. Harvest area is at its lowest in decade 9 when the OGMA/MMA stands are allowed to shift on the land base and make older, high volume stands available for harvest. Over the entire planning horizon, the annual harvest area averages 2,556 ha (unsalvaged losses area removed).

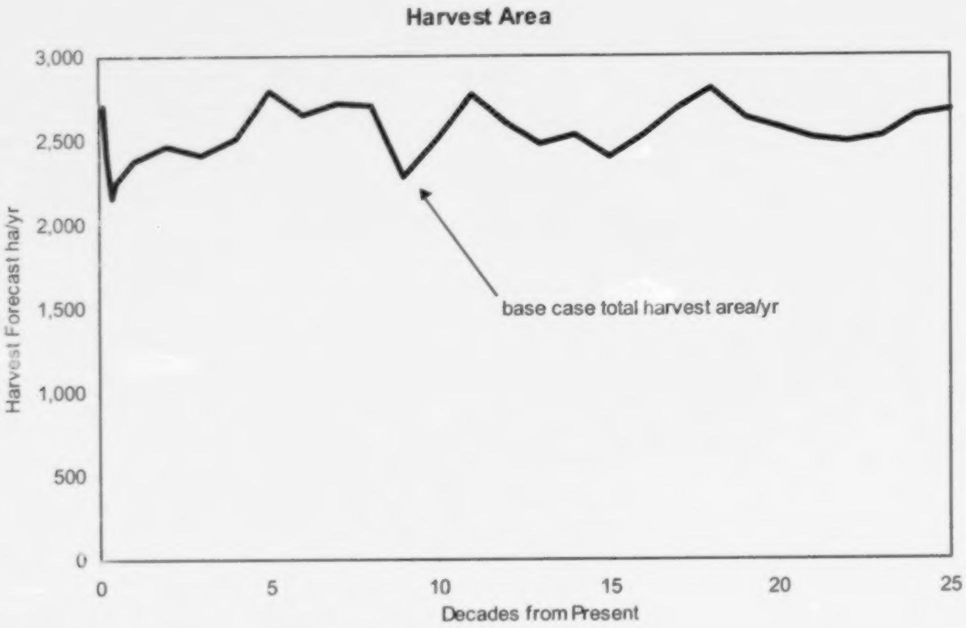

Figure 19. Total harvest area per year - Invermere TSA base case

4.3.3 Seral Stages

The figures below illustrate changes in seral stage composition of the crown forested land base in the TSA over the next 250 years. The seral stages are shown by Natural Disturbance Type (NDT) and use seral stage definitions from the *Landscape Unit Planning Guide* that are based on stand ages. For example, old seral forest in NDT3 is defined as >140 years old, while in NDT 1&4, old seral forest is defined as > 250 years old. In all of these natural disturbance types, a natural disturbance regime has been built into the base case model to emulate the disturbance of forests outside of the timber harvesting land base - see Section 3.4.2 above for more detail.

NDT 1 forests are generally wetter, higher elevation forests in the Invermere TSA and are characterized by infrequent stand replacing disturbances. Only ESSF wm variants fall within this NDT[6] and together they make up less than half a percent of either the CFLB area or THLB area. The total CFLB area of these variants is 2013 ha with approximately 39% of this area occurring in the THLB.

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[6] The Biodiversity Guidebook states that ESSF wm variants are considered to be NDT1 north of Crawford Creek and NDT2 south of Crawford Creek. This analysis considered the Invermere TSA to be north of Crawford Creek.

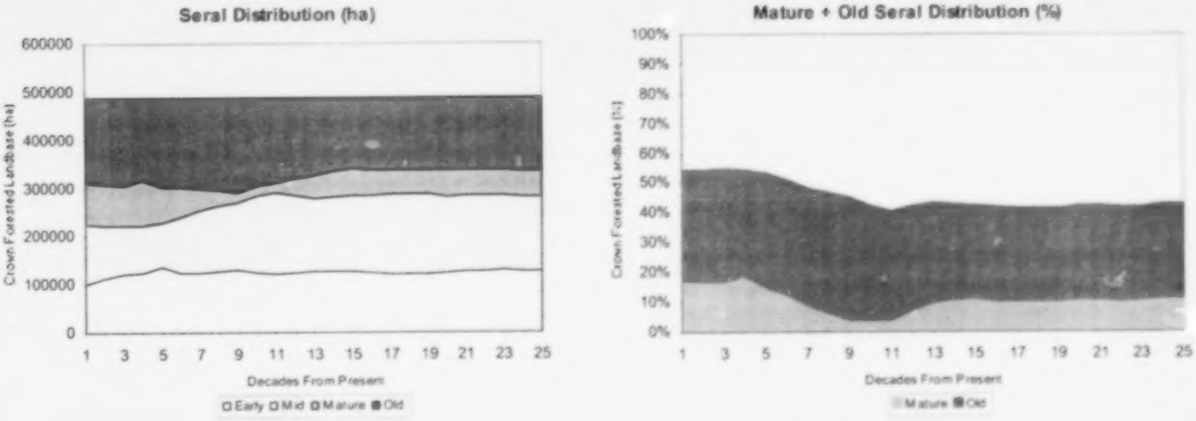


Figure 20 Seral distribution of Natural Disturbance Type 3 forest

NDT 3 forests are drier forests than NDT 1 and are characterized by larger stand replacing disturbances, like wildfire. In the Invermere TSA, NDT 3 forests dominate the CFLB area (88%) and the THLB area (81%), with the majority of this area coming from the ESSFdk1 and MSdk variants. Old and mature stands in NDT3 currently represent 54% of the CFLB area. This area decreases to a long term average of 42%, primarily due to the shifting of mature forest area into mid-seral forest area (Figure 20). This occurs because stands in the THLB are often harvested close to their minimum harvest age, meaning little time is spent in the mature seral stage. Modeled seral goals on old and mature forests ensure that the levels required by the Higher Level Plan Order are maintained across the land base. The implementation of disturbances in the Non-THLB recreates mature forests and ensures currently mature stands do not all end up as old in decade 25.

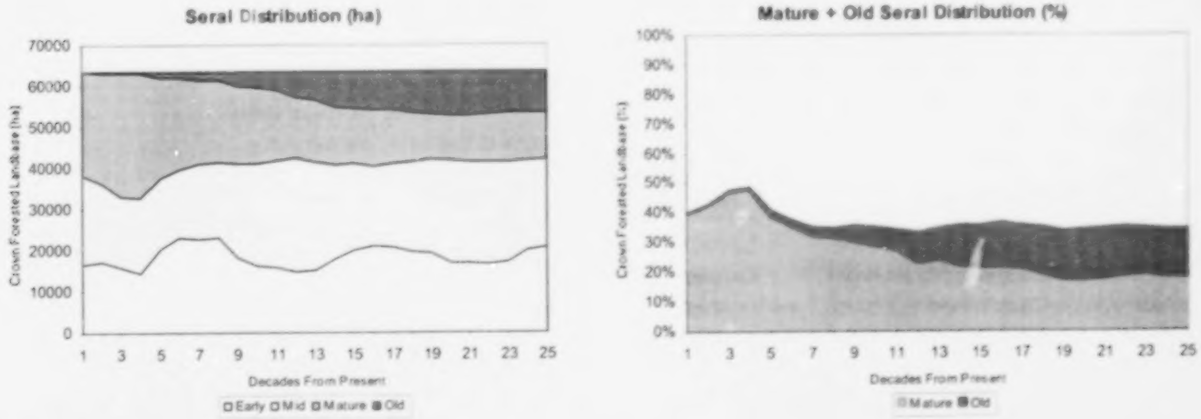


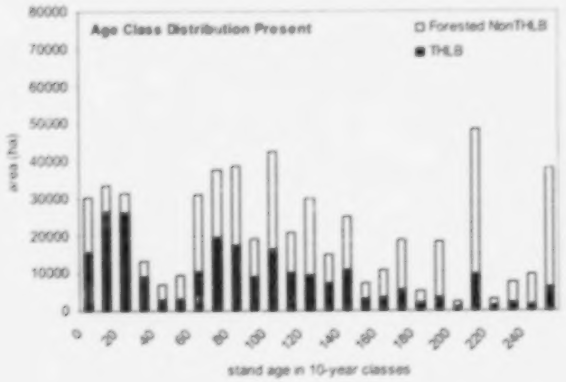
Figure 21 Seral distribution of Natural Disturbance Type 4 forest

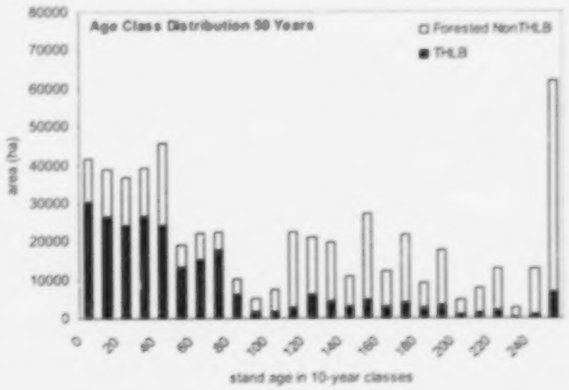
NDT 4 forests are the hottest and driest forests in the TSA and are characterized by frequent, stand maintaining disturbances, such as light ground fires. NDT 4 areas in the Invermere TSA make up 12% of the CFLB area and 19% of the THLB area. Old and mature stands in NDT3 currently represent 40% of the CFLB area but this is almost entirely comprised of mature seral stands. This occurs because the current inventory ages for these stands are rarely over the 250 year old threshold that defines 'old' in this NDT. Many of the mature stands actually contain characteristics of old seral stands but the age based definition old seral for NDT4 does not fit well with the stands of this TSA. Over the planning horizon, the existing inventory ages so that gradually a larger potion of these stands is considered old (16% after decade 19). The total area of old and mature stands declines to a long term average of 35% beyond decade 7 and remains quite stable. This loss of old and mature shows up as slight increases in the long term levels of early and mid seral stands. As in NDT3, this occurs because stands in the THLB are often harvested close to their minimum harvest age, meaning little time is spent in the mature seral stage. Modeled seral goals on old and mature forests ensure that the levels required by the Higher Level Plan Order are maintained across the land base. The implementation of disturbances in the Non-THLB recreates mature forests and ensures currently mature stands do not all end up as old in decade 25.

An assumption imbedded in the modeling of seral goals for all Low BEO units, is that full old seral targets are met by year 240 (three rotations). This has been confirmed to be true but for one exception. The IDF xk portion of the Kindersley/MaCauley Landscape Unit (10 ha of CFLB) does not meet the target over this time frame. The small area of this units makes it insignificant.

4.3.4 Age Class Distribution

Figure 22 provides a time-series showing the age-class distribution of the TSA's forest in 50 year increments. The present day stand ages are well distributed over a wide range of age classes, with most area falling within the 0-20, 80-140, 210, and greater than 250 age classes. The spike of area at 210 years is likely an artifact of midpointing older stand ages during forest cover typing. The age on non-contributing forest is fairly well distributed amongst all of the age classes but there does appear to be a trend toward lower %THLB areas at older age classes. There is presently very little forest between 30 and 50 years of age on the TSA. This is one of the main factors contributing to the mid-term harvest reduction and can be seen in the 50 year snapshot, where very little timber harvesting land base is available in stands greater than 80 years of age. By 100 years into the future (just prior to the start of the long-term harvest level), the timber harvesting land base is becoming evenly distributed between 0 and 80 years of age.





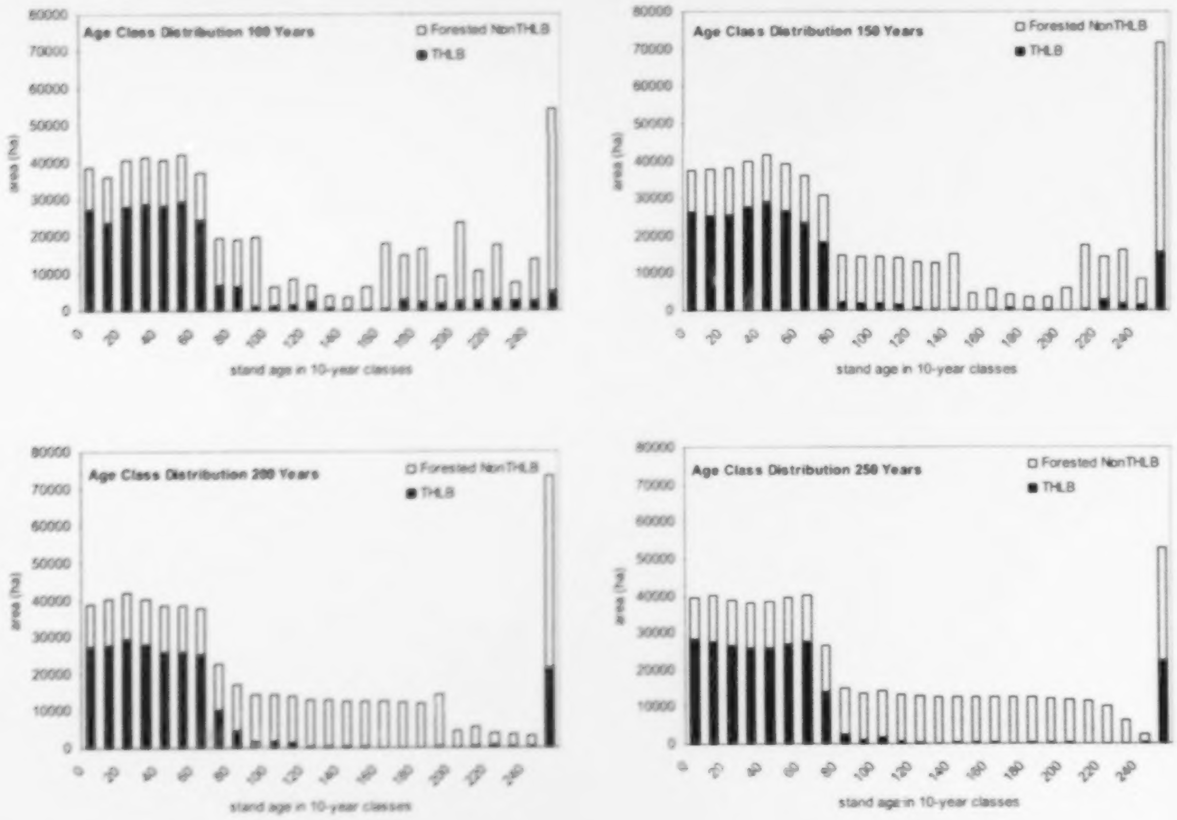


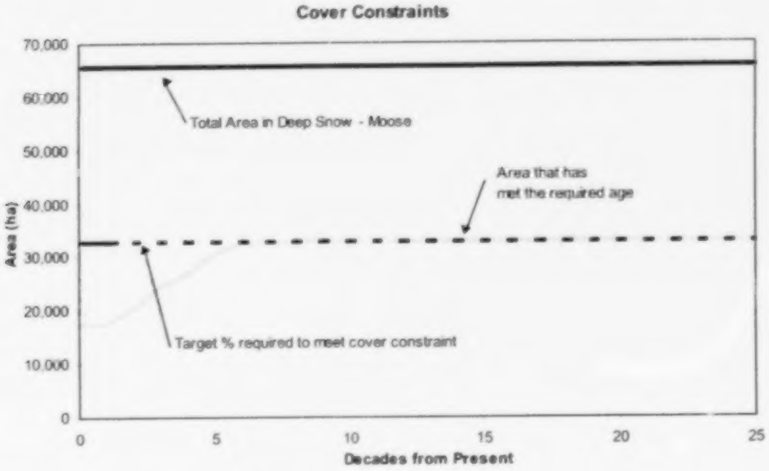
Figure 22. Age class composition of the Invermere TSA: six snapshots from the base case

The 250 year snapshot shows an even distribution of THLB stands in the 0-70 year age classes with smaller amounts of area in the 80-120 year classes, corresponding with stands with longer rotation ages.

The modeling of natural disturbance in the non-THLB leads to the creation of an even distribution of NonTHLB stands through all of the age classes. The 250 year snapshot shows a well-distributed non-contributing land base and a large area of non-contributing that has aged to > 250 years old. Also of note in the 250 year snapshot is that over 24,400 ha of THLB exists in ages over 150 yrs, with the vast majority coming from stands over 250 years old. These are areas of THLB that are constrained to an extent that timber harvesting is prevented, and represents over 10% of the long-term timber harvesting land base.

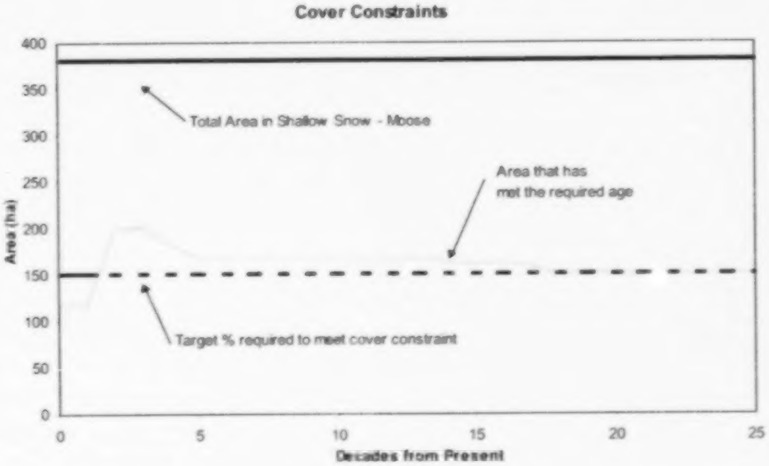
4.4 Constraints Analysis

In the base case analysis, several cover constraints are modeled to ensure that non-timber values are represented on the land base. These constraints address issues related to wildlife habitat, biodiversity, and visual quality and are described in Section 3.3.1. This section of the report provides a summary of some of the most significant cover constraints modeled in the base case, and how the various constraints are being met over the 250 year planning horizon.



In the KBLUP Ungulate Winter Range (UWR) areas, constraints were modeled for the species with the greatest cover requirement. In the deep snow zone, 65,835 ha of forest have moose cover constraints of 50% >120 yrs old applied (therefore 32,918 ha > 120 yrs old). In these moose zones, only 17,585 ha currently meets this criteria, and it is not until the 5th decade that there is sufficient forest > 120 yrs old to meet the moose constraint. From the 6th decade onward, forest > 120 yrs old is maintained at a steady 50% of the zone. See Figure 23. This figure shows the collective result of all deep snow-moose zones, even though the constraint is actually applied and modeled at a more detailed level, within each landscape unit. This constraint is limiting harvest throughout the planning horizon.

Figure 23. KBLUP ungulate winter range - deep snow moose - 50% required to be > 120 yrs old



There are 380 ha of KBLUP UWR – shallow snow moose zone, which have a cover constraint of 40%>80 yrs old (therefore 152 ha > 80yrs). In these shallow snow moose zones, only 115 ha currently meets this criteria. The constraint is met in the 2nd decade. From the 2nd decade onward, forest > 80 years old is maintained at a level above the required 40%. See Figure 24. The constraint appears to be limiting harvest in the very early periods and late periods of the planning horizon.

Figure 24. KBLUP Ungulate Winter Range - Shallow Snow - Moose - 40% required to be >80yrs old

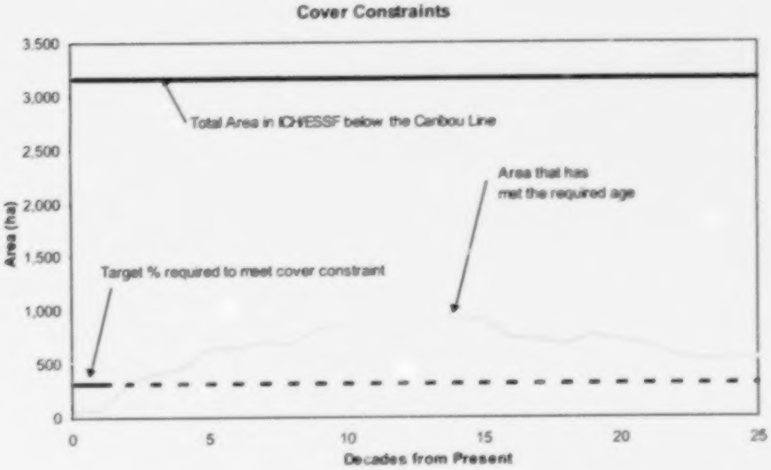


Figure 25. HLPO caribou - 10% required to be > 250yrs old

In the HLPO caribou zones several cover requirements are applied. One of which is that below the Caribou Line in ICH and ESSF forests, 10% of the forest is to be maintained > 250 yrs old. This zone covers 3,166 ha of forest so the target area is 317 ha. There is currently only 69 ha of 'old' forest in this zone so the constraint is not met until decade 2. Beyond this period, the amount of area continues to increase, reaching a maximum of 28% in decade 15. See Figure 25. This constraint may be limiting harvest in the very early years of the planning horizon but is not limiting harvest after 20 years. The associated mature goal applied to the same area maintains the required level of old by default. In general, the caribou zones are limiting harvest throughout the planning horizon because of their significant retention requirements, but they only impact 1.1% of the THLB (2534 ha) and thus have little impact on the TSA harvest levels.

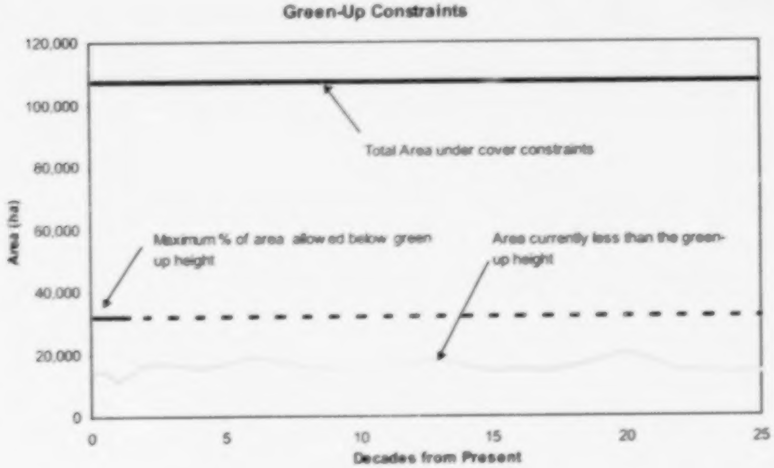
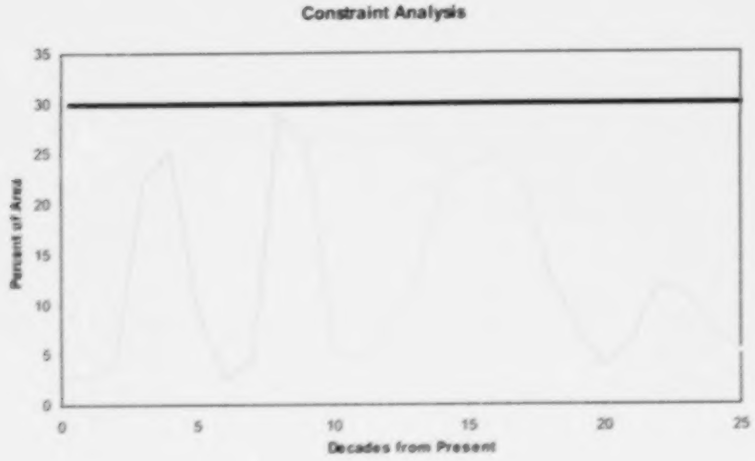


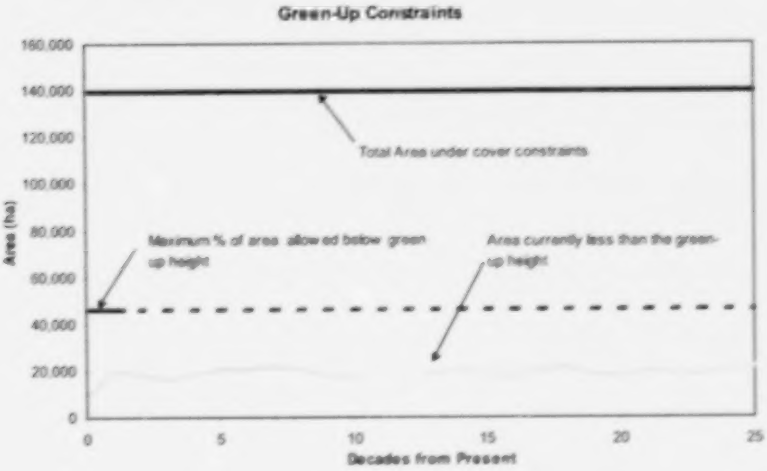
Figure 26. Community, domestic, and high value watersheds - maximum of 30% < 6m tall

Green-up constraints are different than cover constraints. Cover constraints ensure a specific type/amount of forest remains on the land base. A green-up constraint limits the type/amount of disturbance that can occur on the land base. In the case of community and domestic watersheds, a maximum of 30% of the forest within the watershed is allowed to be below 6m tall at any one time. Zones where the constraint is not met cannot having timber harvest occurring. Figure 26 shows the collective sum of all community, domestic, and high value watersheds. Individual watersheds may have significantly higher variation over time (see Figure 27) but overall the total area of watersheds below the 6m green-up is near 15% for most of the planning horizon. This is because only 31% of the watershed area falls within the THLB and economic rotation ages provide a large portion this requirement by default. Thus, at the TSA level this constraint does not appear to limit harvest.



As a comparison to Figure 26, a single Domestic Watershed zone is shown in this figure. In the Nine Mile-Moscow landscape unit, this 444 ha watershed does show that the green-up constraint does achieve levels over 20% in several periods. This figure is intended to demonstrate that even though the TSA rollup of watershed green-up constraints indicate an average 15% ECA, there are some locations in the TSA where ECAs get significantly higher. This circumstance tends to occur in smaller watersheds where harvesting a single block can have a proportionally higher impact.

Figure 27. Nine Mile-Moscow LU - watershed greenup constraint - maximum 30% < 6m



The integrated resource management (IRM) zone is the area of timber harvesting that is outside of VQO's and outside of the Enhanced Resource Development Zone. IRM areas are subject to standard cut-block adjacency and green-up requirements. The IRM green-up constraint is intended to emulate cutblock adjacency and/or patch size management in the model. The IRM greenup requirement was modeled on 139,543 ha of THLB and limited stands under 2.5m tall to a maximum of 33%. Figure 28 provides a rollup of all the IRM zones in the TSA and indicates that approximately 12-13% of the area is less than 2.5m tall for the majority of the planning horizon. This corresponds well with the average rotation age of 84 years. Individual IRM zones within separate landscape units may at times be closer to the maximum percentages. A review of each IRM zone indicated that occasionally percentages reached 25% but rarely reached 33%.

Figure 28. Integrated resource management zone - maximum of 33% < 2.5m tall

Visual quality objectives are met by applying a maximum disturbance percentage to areas in the model. Figure 29 shows a rollup of VQO areas where the maximum disturbance is 15% - which includes some retention, partial retention and modification visual quality zones (see Appendix B). The graph shows that the model is generally harvesting up to the maximum allowable disturbance (15% for these areas) throughout the planning horizon. The same trend can be seen with 7.5% and 12.5% VQO constraints. VQO constraints limiting disturbance to 17.5% and greater were generally not constraining harvest during the planning horizon.

The impact of VQO constraints is influenced by the proportion of the VQO that is in the THLB, and the overlap with other constraints, such as UWR.

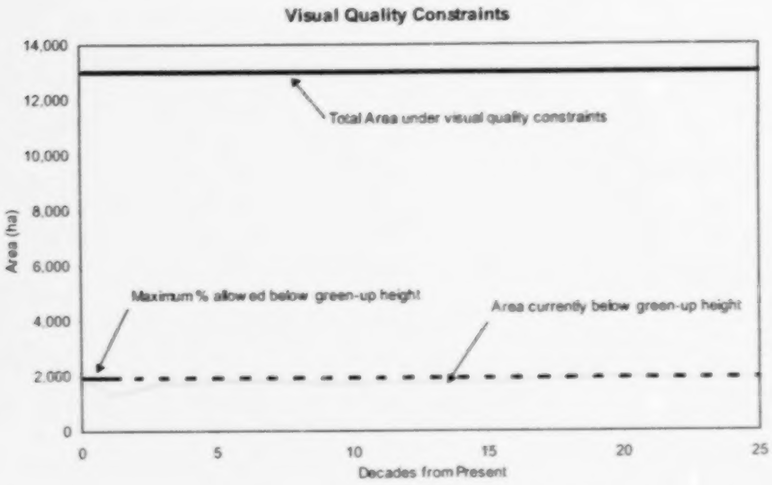


Figure 29. Visual quality constraints for maximum planimetric disturbance of 15% < green-up height

How each of these constraints interact to impact timber supply in the Invermere TSA is important toward understanding the base case harvest flow presented in this report. The impact that any forest management constraint will have on harvest is driven by two main factors; 1) the cover requirement of the constraint, and 2) the area extent of the constraint. For instance, a VQO polygon constraint can severely limit timber harvesting with a low allowable disturbance, such as a maximum of 5% < 7.5m green-up height, but the area of the VQO polygon being managed may be quite small relative to the size of the TSA. Conversely, broad cover constraints, such as the KBLUP Ungulate Winter Range, cover a very large area and can have a greater impact on timber supply.

In order to understand how constraints influence the harvest flow, it is important to know which constants are tight and how often they are tight. Tight constraints occur in areas where forest cover conditions have reached maximum or minimum conditions (i.e. a zone has 15% of its area below greenup age and the maximum allowable is 15%). When maximum conditions are met, harvest is prevented from occurring in the group. When minimum conditions exist (i.e. 10% old is required and 10% or less exists), harvest can still proceed in the remainder of that zone if any eligible stands remain after setting aside the full requirement in the oldest possible stands. However, if minimum constraints are tight it means that the constraint is actively working to prevent harvest in the % area required – as opposed to the percentage simply being met as a result of some overlapping constraint. This is critical for understanding whether changes to a constraint would translate into changes in harvest availability.

The percent of each constraint group area that is at threshold values (tight constraints) is shown in Figure 30 and gives a relative indication of which constraints are limiting on the land base. Figure 31 gives a sense of the overall significance of each constraint group by providing the absolute areas that are impacted.

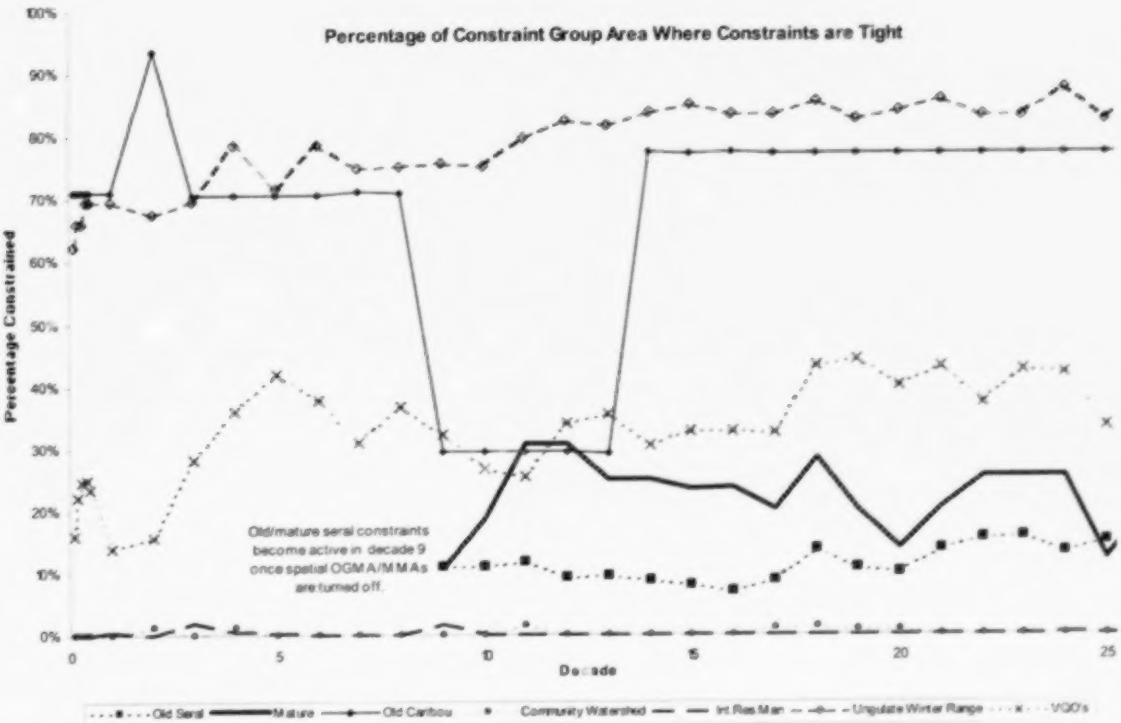


Figure 30. Overview of Constraints - % Area Tight

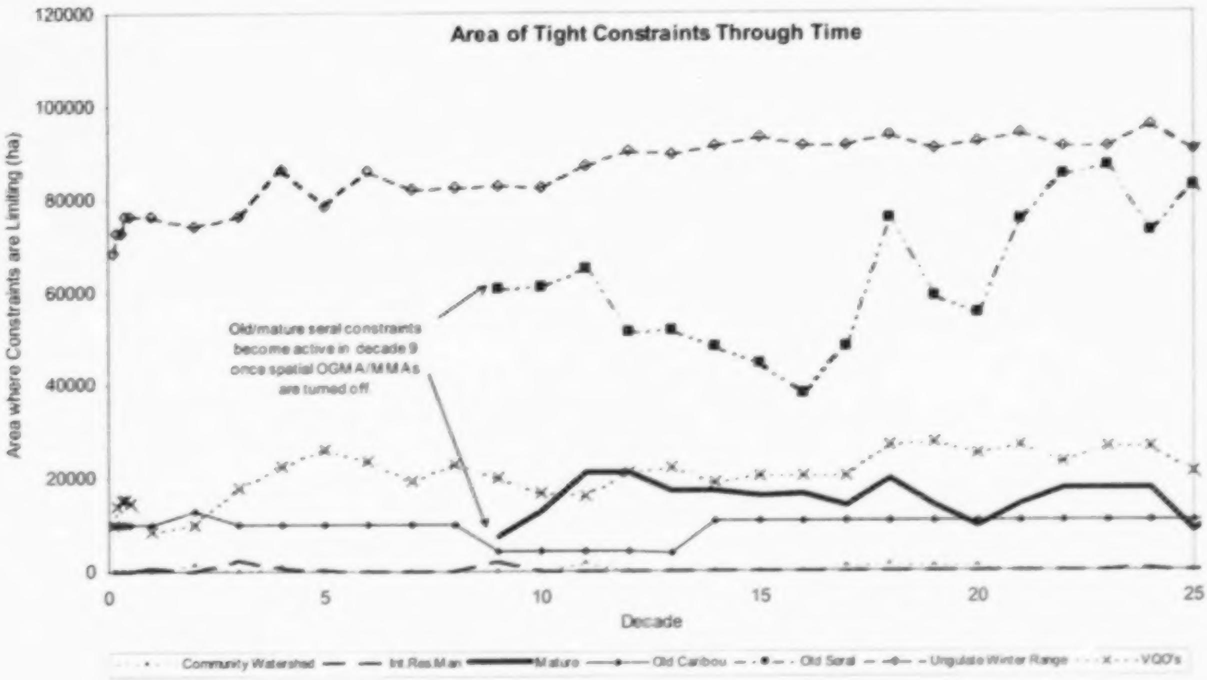


Figure 31. Overview of Constraints - Areas with Tight Constraints

Ungulate Winter Range objectives appear to be actively impacting harvest levels in 70-80% of the mapped UWR area or approximately 70,000 - 90,000 ha. The increase over the planning horizon occurs because harvesting draws down the amount of mature stands through time to the minimum level required by winter range constraints (i.e. becomes limiting). This broad area of UWR has constraints applied that require anywhere from *25 to 50% of the zones to be maintained in mature stands. Thus, UWR constraints are significantly limiting* harvest over large areas of the Invermere TSA.

Old seral goals in Figure 30 show only about 10-15% of the constraint group area as tight over the planning horizon, but Figure 31 shows that it effects the second largest area behind UWR. This is because old seral objectives are applied to the entire land base. Figure 31 shows that over the planning horizon, groups representing anywhere from 40,000 to 80,000 ha contain just enough old stands to meet the minimum requirement and thus are actively preventing harvesting of those old stands. More areas are not limiting because many of the LU-BEC combinations contain significant areas of NonTHLB forest. A similar circumstance is true for mature seral goals except the % area that is tight is higher (average 20-25%) and the area covered by mature constraints is much lower (10,000 – 20,000 ha over the planning horizon).

Collectively, VQO's are constraining in 30-40% of the total area in VQO groups, or 15,000 to 25,000 ha of CFLB forest over the planning horizon. As noted earlier, this generally corresponds with the VQO polygons with disturbance limits of 15% or less. Because VQO's are maximum disturbance constraints, timber harvesting is minimal in this 15,000 to 25,000 ha of forest with tight constraints over the planning horizon. Harvesting is only able to capture growth that occurs in each time period. It is important to note that only a portion of this area is timber harvesting land base.

The figures above also show that, on average, 70% of the caribou areas are limiting harvest over the planning horizon. Thus harvest is significantly impacted by caribou habitat requirements within the small area where it is relevant (2,534 ha or 1.1% of THLB).

Both watershed ECA constraints and IRM greenup constraints appear to be almost completely non-constraining. There is often zero hectares or 0% of the constrained area in a tight condition. These two constraints are having little to no impact on the base case harvest flow.

In summary, Figure 31 indicates that UWR and old seral goals are having the largest impact on the base case harvest forecast, while VQOs, mature seral goals, and caribou constraints are influential but less constraining at the TSA level. The least constraining on the harvest forecast appear to be IRM and watersheds constraints.

5.0 Base Case Differences from TSR2

Relative to TSR2, the base case presented here shows a significantly improved harvest forecast. This section is meant to summarize and explain, where possible, the main differences between the harvest flows. Detail on the different inputs and assumptions included in the two analyses can be found in Section 3.6.

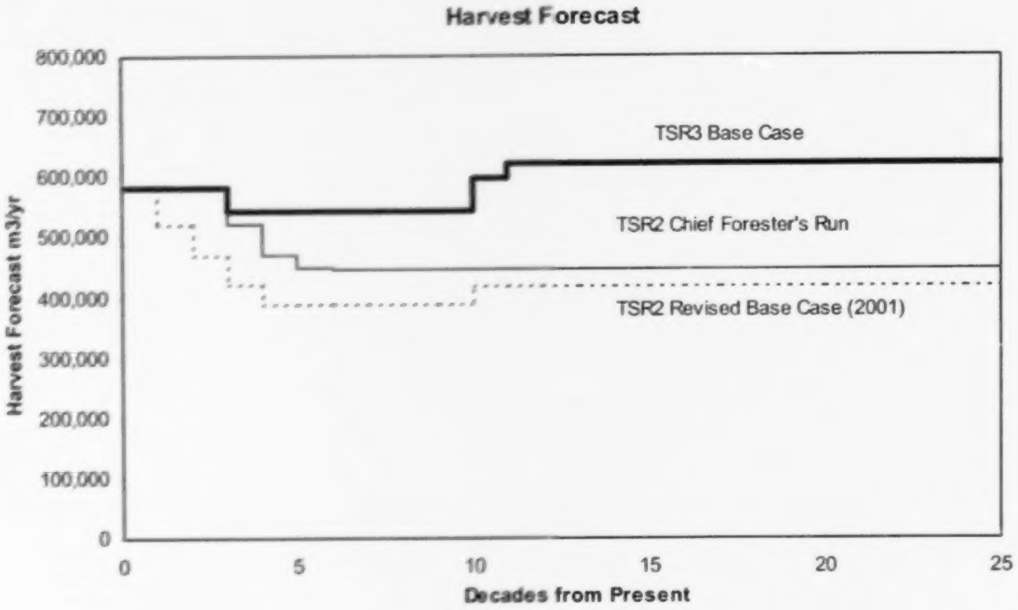


Figure 32. TSR2 and TSR3 harvest projections

Comparisons made below are made relative to the TSR2 revised base case run shown in Figure 32. It should be noted that time zero in the TSR2 run was 6 years earlier than time zero in Figure 32, although the graph presents then both using 2003 as time zero.

Downward pressures on TSR3 base case timber supply relative to TSR2

- The current THLB is 2-3% smaller than in TSR2. It is difficult to determine the exact difference because of different reporting and analysis methods. TSR2 chose to address several netdowns with yield curve reductions, while the same issue in TSR3 used reductions to the THLB. Thus, THLB size looks different but the net impact on timber supply could be similar. Several factors that did result in true reductions of the THLB area in TSR3 are larger riparian, problem forest type, and low site netdowns, larger netdowns for existing trails and landings, exclusion of NP-Backlog NSR, and a potentially larger inoperable area. This reduction was partially offset by fewer hectares removed as unstable terrain.
- The Integrated Resource Management Zone greenup height is now 2.5m as per HLPO direction. This was modeled as 2m in TSR2.
- HLPO connectivity rules are now embedded in the spatially located OGMAs used in TSR3. This factor was not present in TSR2. Sensitivity analyses have shown that this likely had no impact because of the way pine stands in the THLB are handled in the allocation sequence.

- The KBLUP Moose UWR guidelines were modeled in TSR3, while they were not modeled in TSR2.
- The KBLUP UWR guidelines were modeled for all species in shallow snow zones, while they were not modeled in TSR2.
- A more literal application of HLPO caribou rules in TSR3 results in a more restrictive forest cover requirement than was applied in TSR2.
- TSR3's approach to partial cutting and in-block retention varied significantly from TSR2. Without the OAF values used for WTR in TSR2, it is difficult to tell but TSR3 appears to be more pessimistic in the short term and more optimistic in the long term – although the scale of the difference is likely small.

Upward pressures on timber supply relative to TSR2

- TSR3 applies full mature seral goals in specific LU-BEC combinations as required by the HLPO (Oct 2002). This resulted in less than 12% of the CFLB having mature seral goals applied. TSR2 applied mature seral constraints over the entire land base with a draw down to 1/3 in Low BEOs. The TSR3 scenario results in a significant improvement in timber supply over TSR2 throughout the planning horizon.
- TSR3 contains volume gains associated with the use of select seed in managed stand yield curves. No such gains were modeled in TSR2. This difference improves long-term yields and help with short and midterm harvest levels through shorter rotation ages for managed stands.
- TSR3 contains improved estimates of site productivity for managed stands in the base case (SIBEC adjustment applied to 88% of the THLB resulted in a 2.5m increase in average site index). This greatly improves mid and long-term timber yields as stands grow more quickly and/or contain more volume. Lower minimum harvest ages helps availability of managed stands in the midterm trough, allowing improved short-term flows as well.
- Regeneration delays for analysis units have decreased by about 1-2 years.
- In community and domestic watersheds, the ECA is now modeled as 30% (instead of 20%), reducing the constraint on timber harvesting. This was a recommendation of the MoF Regional Hydrologist (Dave Gluns, PEng).
- Again it is difficult to know, but the TSR2 approach to partial cutting appears to have significantly limited the long term harvest level. The TSR3 approach to this issue and factors such as select seed and site index adjustments, help to explain the difference between the two long term levels.

Unknown or similar influence on timber supply relative to TSR2

- OGMA's and Mature Management Areas (MMA's) are spatially defined in TSR3 for the first 8 decades of the analysis.
- There are numerous other differences between TSR2 and TSR3 as listed in Section 3.6 but their impact on timber supply is unclear.

6.0 Timber Supply Sensitivity Analyses

The data and assumptions used in timber supply analysis are often subject to uncertainty. To provide perspective on the impacts of changes to data or assumptions, sensitivity analysis is commonly performed. Usually only one variable (data or assumption) from the information used in the base case is changed in order to explore the sensitivity of that variable. Sensitivity analysis is a key component of any Timber Supply Review process. Sensitivity analysis permits the determinant (the Chief Forester) to gauge the potential impact of uncertainty around assumptions and data that make up the base case. Sensitivity analyses help to frame the potential impacts of uncertainty by analyzing scenarios that are more pessimistic and more optimistic than the base case.

Selecting sensitivities to analyze is important, since the sensitivities need to be relevant to the management unit and meaningful to the determination. In this TSR, the sensitivities listed below were selected because they reflect issues critical to the Invermere TSA and/or are critical to provide perspective to the Chief Forester for the AAC determination.

Table 5. Completed Sensitivity Analyses

Sensitivity analysis	**Zone/ group / analysis unit subject to uncertainty**	**Suggested Changes in Sensitivity Run**
Size of THLB	Timber Harvesting Land Base (THLB)	The timber harvesting land base will be increased and decreased by +/– 10%.
Managed Stand Yields	Managed Stands	The volume associated with managed stands will be increased and decreased by +/- 10%
Natural Stand Yields	Natural Stands	The volume associated with natural will be increased and decreased by +/- 10%
Open Range / Open Forest Yields	OR/OF AU's	Volume contributions from OR/OF stands will be reduced to zero to assess importance of these areas to timber supply. Volumes from subsequent OF entries will be reduced by 50% to explore possible impacts of managing for range values.
Minimum Harvest Ages	All Stands	Minimum Harvest ages will be increased and decreased by +/- 10 years.
Harvest Priorities	Timber Harvesting Land Base (THLB)	Oldest First harvest rule replaced with Random and Relative Oldest First.
Regeneration Delays	Future Managed Stands	Regeneration delays increased to 3 years for stands using 1 year in base case. OR/OF and FdPy regen delays remain at 10yrs.
Gains from Planting Select Seed	Future Managed Stands	No gains applied to future managed stands (no select seed use). 2013 gains applied to future managed stands (2013 seed used).
Full SIBEC	All Managed Stands	Apply SIBEC adjustment in all BEC variants. The base case only applied SIBEC in the 5 main BEC variants (88% of THLB addressed).
New Ungulate Winter Range Guidelines	Wildlife	Implement the new ungulate winter range (PEM) guidelines (new line work and constraints, lower OF yields).
New Caribou Guidelines	Wildlife	Model the new caribou strategy based on habitat types and tree species.
OGMAs / MMAs	Crown Forested Land Base	Apply seral goals from time zero instead of spatial OGMAs/MMAs
Kootenay National Park	Shuswap/Windermere, Pedley, Cross LU's	Remove the KNP from the CFLB of the appropriate LUs.
2003 Fires	Fire stands not salvage logged	70% of the unsalvaged fire areas drop out of the THLB because they regenerate to problem forest types.
Mountain Pine Beetle	Pl Stands >60yrs	50% of susceptible Pl stands (>60yrs, >50% Pl, nonESSF) dead by year 10. Anything not salvaged in 10 years is naturally regenerated (VDYP) with a 20yr (total) delay. Pine harvest capped at 90% of annual cut.

6.1 Size of Timber Harvesting Land Base

Several factors that determine of the size of the THLB have uncertainty around their definitions (operable area, problem types, low sites, riparian management, impacts from trails and landings, etc). Different market conditions in the future or changes in harvesting or milling technology can also serve to reduce or expand the land base considered to be economic.

The timber harvesting land base in the Invermere TSA has decreased by ~3% since the last timber supply review. It is not known whether the THLB used in this analysis has been over- or under-estimated, so two sensitivity runs have been completed. These runs increase and decrease the size of the THLB by 10%.

How was it Analyzed?

Run	How was it Analyzed?
Timber harvesting land base + 10%	The modeled size of each zone in the timber harvesting was increased by 10% to a total of 257,260 ha.
Timber harvesting land base - 10%	The modeled size of each zone in the timber harvesting was decreased by 10% to a total of 210,486 ha.

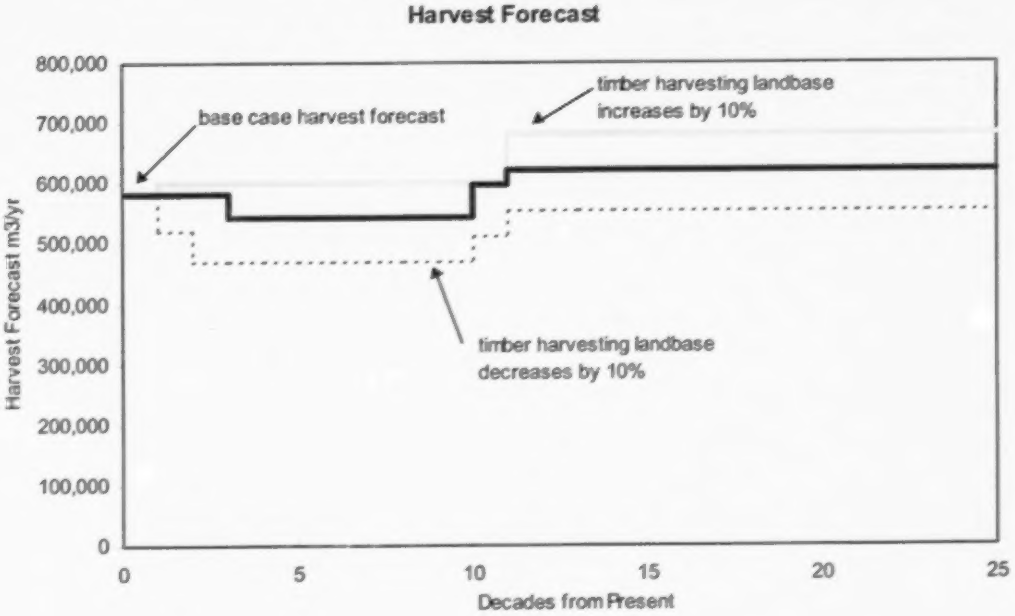


Figure 33. Timber harvesting land base increased and decreased by 10%

Results

Run	Short Term	Mid Term	Long Term
Timber Harvesting Land Base + 10%	The current AAC of 581,570 m3/yr is maintained for 1 decade and then climbs to 601,570 m3/yr for 10 decades.	Higher than base case trough by 11%.	Increase in the long term harvest level of 10% to 681,570 m3/yr.
Timber Harvesting Land Base - 10%	One decade of AAC, then harvest drops to 471,570 m3/yr and is steady for 8 decades. (19% decrease)	The mid-term harvest of 471,570 m3/yr is 13% below the base case.	Long-term harvest level is 11% below the base case at 554,570 m3/yr.

6.2 Yields from Natural and Managed Stands

Stand yields are a critical input into timber supply analysis. The short and mid-term timber supply is heavily influenced by the availability of timber in natural stands that make up the current growing stock. The current standing and mature timber provide all of the timber harvesting opportunities before managed stands begin to come online for harvest. Figure 15 indicated that the supply of natural stands diminishes very quickly by the 5th decade, at which time managed stands start to become more important to the timber harvest profile.

Uncertainty in timber yields can result from many different factors. Natural stand yields are based on the VDYP yield model, which predicts yields from stand attributes in forest inventory maps. Inaccuracies in the model, in decay estimates, or stand attributes can create uncertainties around actual stand yields. The most recent inventory audit indicated that yields from natural stands may be under-estimated by 3.4%, but this difference was considered not statistically significant.

Managed stand yields are based on the TIPSY growth model, which predicts yields from estimates of site index, and stand attributes such as species, density, and expected gains from planting stock grown from select seed. The over or under estimation of any of these factors can lead to uncertainties in the yields of these future stands.

How was it Analyzed?

Run	How was it Analyzed?
Natural Stands + 10%	The yield associated with each natural stand analysis unit was increased by 10%.
Natural Stands - 10%	The yield associated with each natural stand analysis unit was decreased by 10%.
Managed Stands + 10%	The yield associated with each existing managed and future managed stand analysis unit was increased by 10%.
Managed Stands - 10%	The yield associated with each existing managed and future managed stand analysis unit was decreased by 10%.

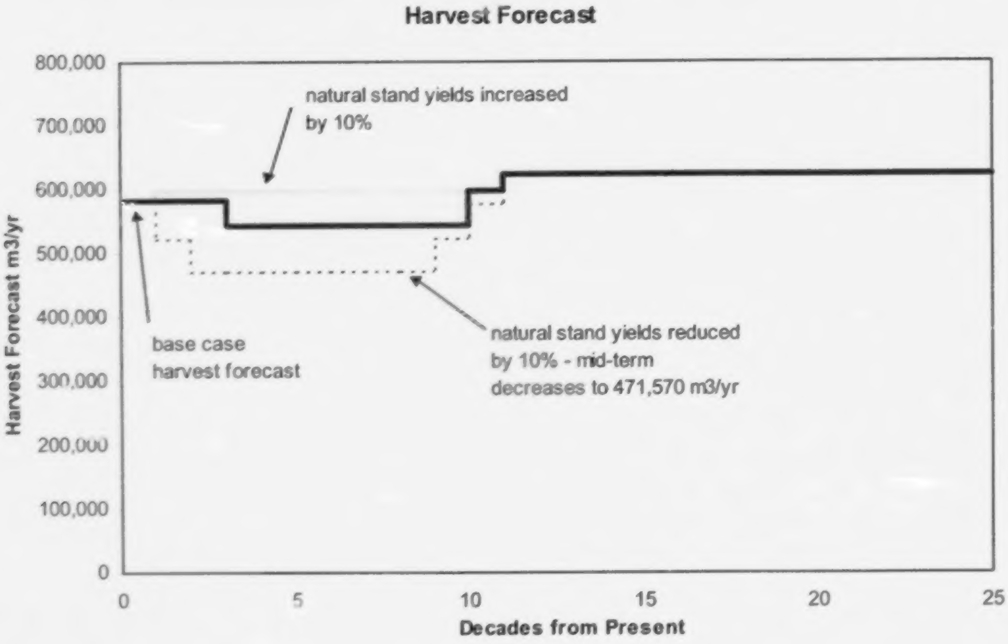


Figure 34. Natural stand yields increased and decreased by 10%

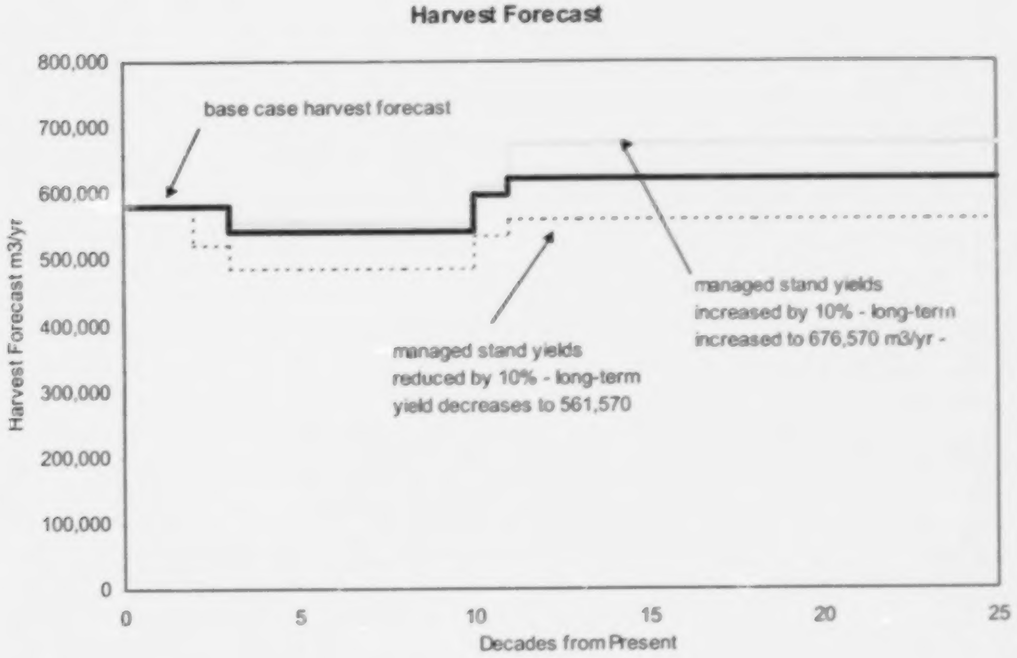


Figure 35. Managed stand yields increased and decreased by 10%

Results

Run	Short Term	Mid Term	Long Term
Natural Stands +10%	The current AAC of 581,570 m3/yr is maintained for 1 decade and then climbs to 601,570 m3/yr for 10 decades.	Higher than base case trough by 11%.	No change.
Natural Stands -10%	One decade of AAC, then harvest drops to 471,570 m3/yr and is steady for 7 decades. (19% decrease)	Trough is deeper than base case by 13% (471,570 m3/yr).	No change.
Managed Stands +10%	No change	Higher than base case trough by 3%.	Increased to 676,570 m3/yr - increase of 9%.
Managed Stands -10%	One less decade of AAC. Harvest falls in decade 3 by 10%.	Trough deeper than base case – down 10% to 488,570m3/yr.	Decreases to 561,570 - decrease of 10%

6.3 Yields from Open Range / Open Forest Yields

In the hot, dry Rocky Mountain Trench, decades of wildfire suppression have lead to overly dense stands on sites that use to provide Open Forest and Open Range conditions. Restoration of these sites is occurring when forest licensees have the opportunity to enter these stands and reduce the stand density. As discussed earlier, the THLB area associated with Open Range (1,535 ha) and Open Forest (8570 ha) is relatively small (4.3%) and contributes about 5% of the harvest in the first decade and about 1% afterwards.

These restoration treatments can be economically marginal and stands may not be harvested if timber prices are too low, or the timber products are unsuitable for existing markets. In addition, management treatments for

Open Forest areas are expected to provide a significant contribution to range habitat (50%) and thus volumes from subsequent harvests are somewhat uncertain. The base case assumes that roughly half of the regular natural stand (VDYP) volume will be available at subsequent Open Forest entries. Sensitivity analyses have been run to examine both of these issues. The first sensitivity takes a worst case scenario approach and assumes that all OR/OF sites are uneconomical to log and no volume is realized from their treatment. The second examines the impacts of reducing the volume expectation from subsequent Open Forest harvests to 25% of regular natural stand (VDYP) yields.

How was it Analyzed?

Run	How was it Analyzed?
Open Range and Open Forest no yield	No harvest was permitted from either Open Range or Open Forest analysis units.
Open Forest Future Entry Yields decreased by 50%	The yield of analysis unit 251 was cut in half.

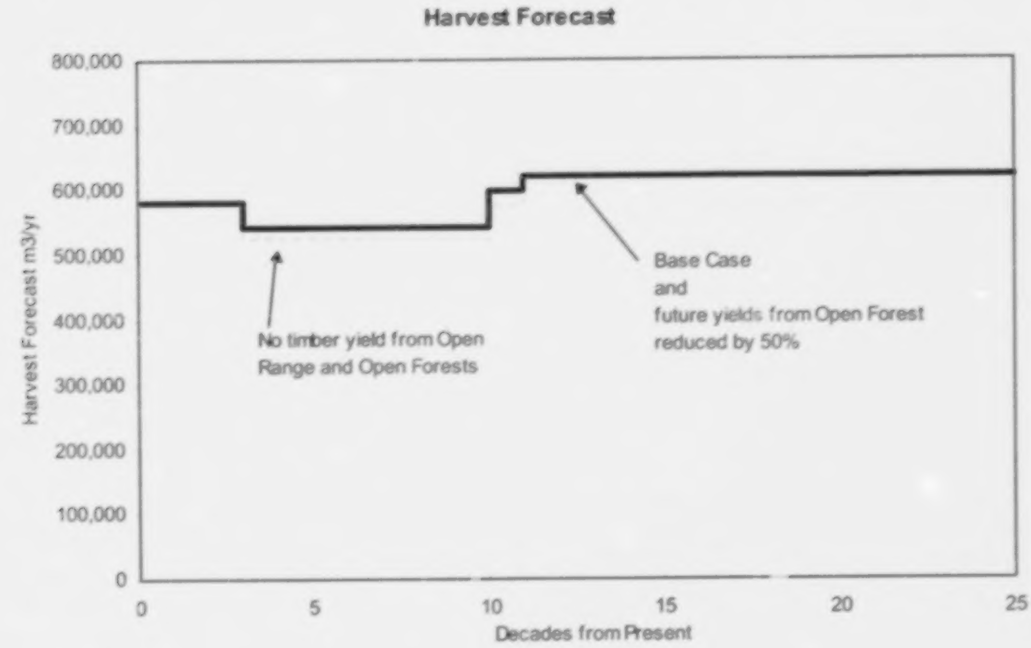


Figure 36. Change in yields from open forest and open range management

Results

Run	Short Term	Mid Term	Long Term
Open Range and Open Forest no yield	No change.	Bottom of trough is lower by 3.5% (523,570 m3/yr).	No change.
Open Forest Future Entry Yields decreased by 50%	No change.	No change.	No change

The contribution of Open Forest and Open Range stands to the Invermere base case harvest forecast is minimal, but the complete elimination of their harvest would have negative consequences on the midterm.

6.4 Minimum Harvest Ages

Uncertainty around the age that stands become merchantable for harvest is linked to both our ability to predict the future growth of stands and our ability to understand future conditions that will define merchantability (markets / products). The large majority of minimum harvest ages used in the base case scenario were based on achieving 95% of the stands maximum mean annual increment (MAI). This age almost always delivered the minimum stand and log requirements (vol/ha, avg dbh) but these criteria occasionally pushed the harvest ages higher. It is important to note that minimum harvest ages are only meant to approximate the time when a stand first becomes merchantable, and that harvesting can and does occur well beyond these ages in the model.

The use of minimum harvest ages associated with maximum MAI's tends to optimize long term harvest levels, but the use of younger ages tends to provide flexibility in the transition from short term to long term harvest levels. The transition from short to midterm harvest levels in the Invermere TSA is heavily influenced by when managed stand volumes become available in significant quantities. It is unknown if there are more appropriate minimum harvest ages than what those used in the base case, so sensitivity runs have been completed to explore the impact of both higher and lower ages.

How was it Analyzed?

Run	How was it Analyzed?
Min Harvest Ages decreased by 10yr	Minimum harvest ages for each AU were decreased by 10 years.
Min Harvest Ages increased by 10yr	Minimum harvest ages for each AU were increased by 10 years.

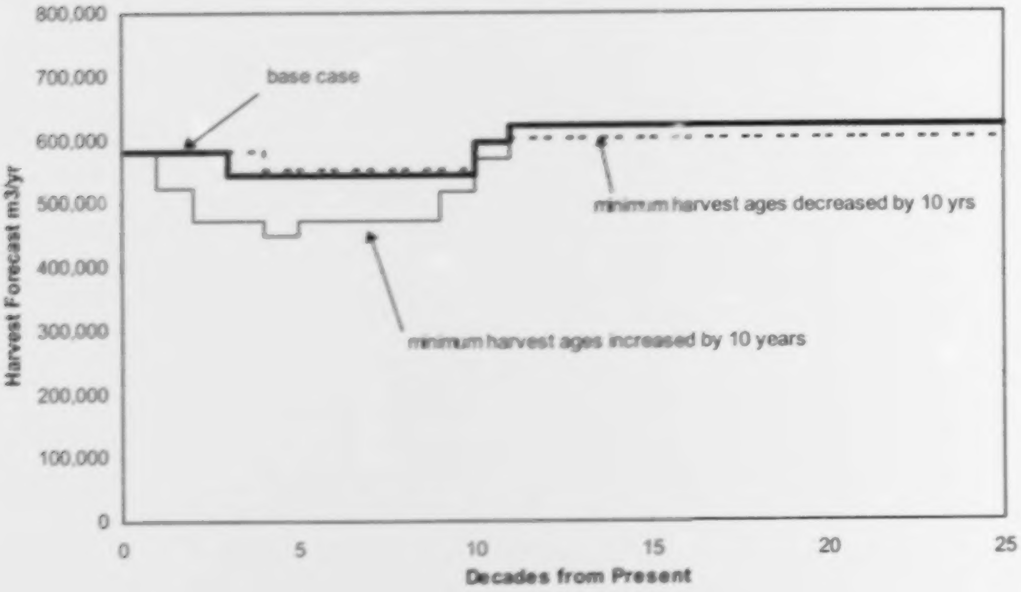


Figure 37. Minimum harvest ages increased and decreased by 10 years

Results

Run	Short Term	Mid Term	Long Term
Min Harvest Ages decreased by 10yr	No change.	One decade of AAC plus trough is higher by 2% to 552,570 m3/yr.	Decrease of 3% to 601,570 m3/yr.
Min Harvest Ages increased by 10yr	One decade of AAC, then harvest drops to 471,570 m3/yr (19% decrease) by 3rd period.	Trough is lower by 17% to 449,673 m3/yr.	No change.

The base case forecast is very sensitive to increases in minimum harvest ages because it delays the availability of managed stands beyond the 5th period. Thus, existing natural stands must be metered out over a longer time frame using a lower short-term harvest level. Decreases in the minimum harvest age result in some additional flexibility in the transition from short to mid term harvest levels because more managed stand volume is available earlier. However, the movement away from maximum MAI results in a 3% decrease in the long term harvest level.

6.5 Harvest Priorities

Harvest priorities help to establish the order in which stands will be scheduled for harvest by the model. The goal is to have the model harvest stands in a manner that is consistent with current management. The District Manager's most recent direction to licensees was to prioritize harvesting as follows: dead timber, susceptible beetle stands, fire maintained ecosystem restoration treatments, available old stands. With numerous recent pressures from bark beetle infestation and fires, licensees are not typically harvesting the oldest stands on the land base. This was recognized in the base case by prioritizing 2003 fire salvage, pine stands susceptible to beetle attack, Open Range/Open Forest stands (to a cap), and finally an absolute-oldest-first priority on the remaining stands.

This sensitivity will look at the effect of replacing the absolute-oldest-first priority in the base case with a relative-oldest-first or random harvest priority. A relative oldest first rule will evaluate stand age relative to a stands minimum harvest age. Stands furthest from their minimum harvest age would have the highest priority for harvest.

How was it Analyzed?

Run	How was it Analyzed?
Random	In the timber supply model – the harvest rule was changed to random from absolute oldest first. All preceding priorities remained the same.
Relative Oldest First	In the timber supply model – the harvest rule was changed to relative oldest first from absolute oldest first. All preceding priorities remained the same.

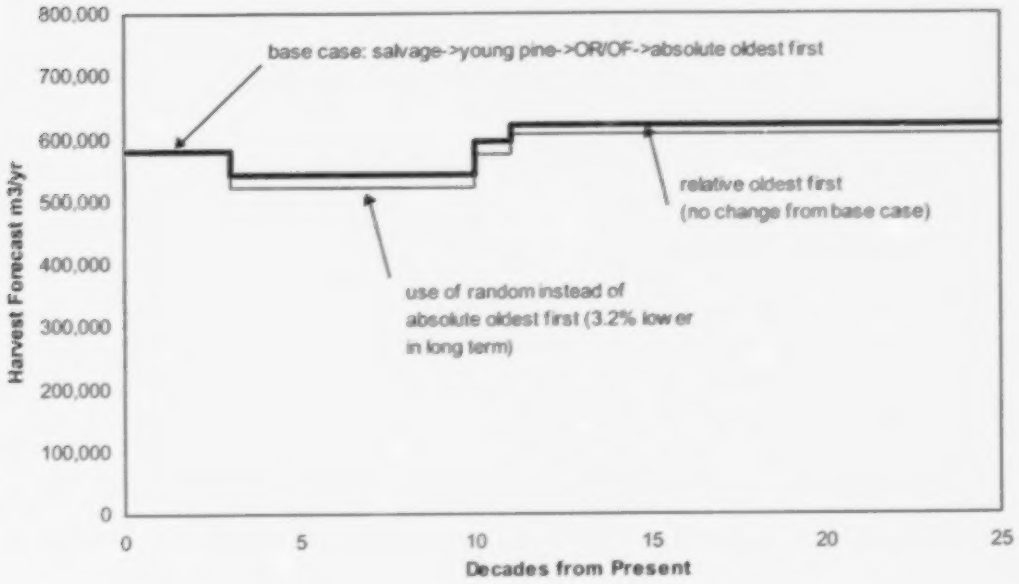


Figure 38. Alternative harvest priorities - random / relative oldest first

Results

Run	Short Term	Mid Term	Long Term
Random	No change.	Bottom of trough decrease 3.7% to 522,570 m3/yr	Decrease 3.2% to 606,570 m3/yr.
Relative Oldest First	No change.	No change.	No change.

A random harvest priority has no impact on the short-term forecast and a 3-4% impact on the mid- and long-term. A short term impact was avoided by dropping a full 10% from the current AAC in decade 3, instead of the 6.7% drop seen in the base case. A relative oldest first priority had no impact on the harvest forecast.

6.6 Regeneration Delays

Regeneration delay is the length of time between timber harvesting and stand re-establishment. Regeneration delays can influence harvest forecasts by impacting the length of time that it takes to meet green-up requirements and the time between harvest entries. The trend in the TSA has been that regeneration delays are getting shorter as licensees are regenerating sites quickly after harvest and relying less on natural regeneration. In the base case, most stands have been modeled with a 1-year regeneration delay. This sensitivity examines the risk of stands taking longer than 1 year, on average, to establish in the TSA.

How was it Analyzed?

Run	How was it Analyzed?
Increased regeneration delays	Analysis units with a 1 year regen delay in the base case were changed to 3 years. In the OF, OR, and FdPy analysis units, the regeneration delay was maintained at 10 years to reflect the challenges associated with natural regeneration in these hotter, drier analysis units.

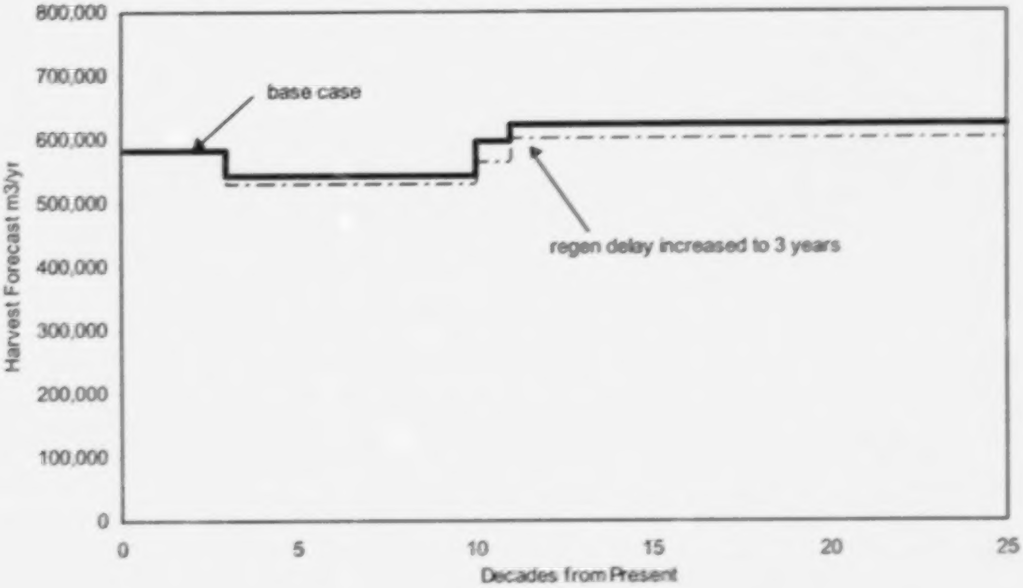


Figure 39. Changes in regeneration delays

Results

Run	Short Term	Mid Term	Long Term
Increased Regeneration Delays	No change.	Trough is lower by 1% and is extended for an additional decade.	Decreased by 3.3% to 601,570 m3/yr.

The length of time that it takes to establish a new stand after timber harvesting is not significant in the short term but it is important for maximizing the long term harvest from the land base. Increasing the time to stand re-establishment impacts the time to achieve green-up, meet forest cover constraints and eventually re-harvest stands. It does not impact the short term because longer regeneration delays do not impact the volume available in decade 4 (pinch point). The managed stands that become available in this period are already established on the land base (existing managed stands).

6.7 Gains from Select Seed

As required by the Forest Practices Code, the TSA uses the best genetic quality seed and vegetative material available for regeneration. The use of select seed from tree breeding programs increases expected future volume yields. TIPSY yields for future managed stands were adjusted in the base case relative to past and current use of select seed (existing Lw-1% and Sx-3%, future Lw-3%, Pl-1%, Sx-14%). Ongoing breeding programs in seed orchards are expected to continue to improve the quality of this select seed and deliver even higher gains than the seed planted today.

The sensitivities shown below examine the impact of using the gains projected for 2013 for all future managed stands (4%-Pl, 14%-Lw, 24%-Sx), and the impact of eliminating all gains from select seed. The later run is completed to understand the risks associated with under performance of select seed.

How was it Analyzed?

Run	How was it Analyzed?
2013 gains from select seed	The expected gains for 2013 seed were applied to yield tables. As in the base case, area weighted average gains were applied to all occurrences of a species (4%-Pl, 14%-Lw, 24%-Sx applied in TIPSY).
No gains from select seed	All gains from the use of select seed were removed from the base case yield tables.

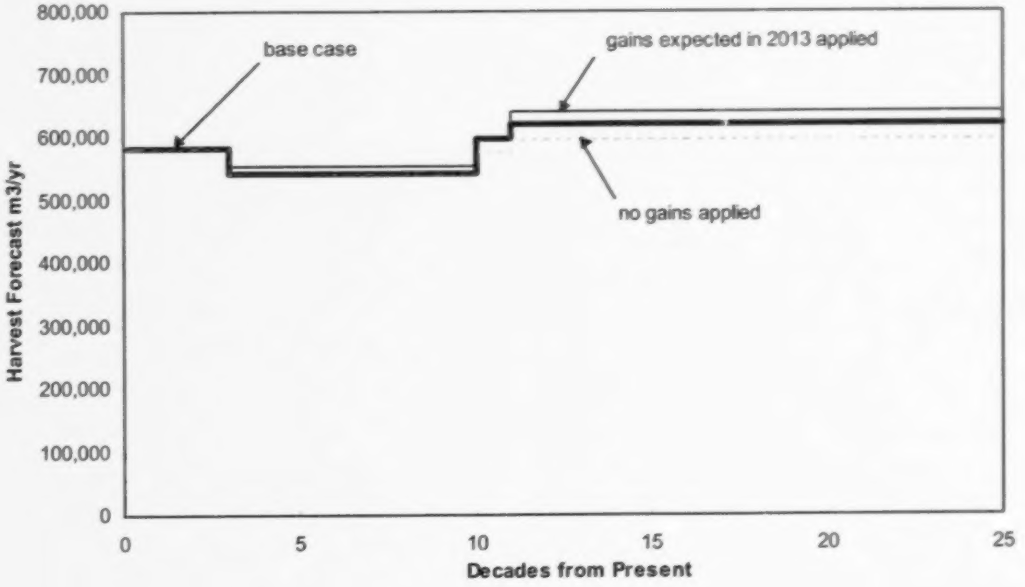


Figure 40. Volumes gains associated with the use of select seed

Results

Run	Short Term	Mid Term	Long Term
2013 gains from select seed	No change.	Trough is higher by 2% to 552,570 m3/yr	Increase in the long-term harvest level by 3% to 641,570 m3/yr.
No gains from select seed	No change.	No change.	Decrease of the long term harvest level of 4% to 596,570 m3/yr.

When no genetic gains are applied to yield tables, there is less volume available from managed stands in the long term. Application of projected 2013 gains on future managed stands provides a small improvement in the mid- and long-term because stands are producing more volume in a given period of time.

6.8 Site Productivity Estimates

The base case analysis included an adjustment of site productivity estimates using ecological relationships for the five dominant BEC variants in the TSA (ESSFdk1, MS dk, ICH mk1, IDFdm2, PP dh2). These BEC variants represent approximately 88% of the THLB. The site index adjustment was restricted to these BEC variants in the base case because only this portion of the ecosystem mapping had an accuracy assessment completed. The remaining area of the THLB contains BEC variants where no accuracy assessment has been completed and therefore no adjustment occurred in the base case. This sensitivity explores the impact of adjusting all site productivity estimates using ecological relationships. This added SIBEC adjustments for the ESSFdk2, ESSFwm, IDF dm2n, and IDFxk.

How was it Analyzed?

Run	How was it Analyzed?
SIBEC Estimates	SIBEC adjustments are applied in all BEC variants where relationships existed – new variants with no SIBEC data (ESSFdk2, IDFdmn2) used crosswalk tables built by the ecologist to assign data from the most similar site series in a BEC variant with SIBEC data. The new site indexes were used to derive changes to future stand yields (new TIPSY yields), changes to green-up ages and changes to minimum harvest ages.

Results

Run	Short Term	Mid Term	Long Term
SIBEC Estimates	No change.	No change.	No change.

The addition of the remaining BEC variants into the SIBEC adjustments did not have any effect on harvest flow. The average site index on the THLB increased by only 0.1% as a result of including the new variants. A larger increase was not seen because of the small area, lack of SIBEC data some of the variants, and some adjustments simply resulted in little change. Where no SIBEC data was available, the inventory site indices were used.

6.9 New Ungulate Winter Range and Caribou Guidelines

Following TSR 2, a committee was struck to examine UWR management practices in the East Kootenay. The committee developed an ecosystem based management strategy for UWR management with objectives for both landscape and stand level management. The committee's UWR mapping is based on habitat types derived from a coarse Predictive Ecosystem Map (PEM). Habitat types were defined based on site series and management objectives are provided for each habitat type (i.e. Open Forest, Open Range, and managed forest units defined by moisture regimes). These new objectives are intended to replace the KBLUP Ungulate Winter Range practices that were modeled in the base case.

A similar scenario has occurred with development of new caribou guidelines. These guidelines define more specific habitat zones and also use leading tree species to determine the forest cover constraint that is to be applied. In general, the new guidelines are more restrictive above the 'caribou-line' and in stand types other than Pl/Fd/Lw. There are almost no restrictions on the harvesting of Pl/Fd/Lw stands below the 'caribou-line'. An HLPO amendment to include these new caribou guidelines is currently in progress and will likely be completed by the time of AAC determination.

How was it Analyzed?

Run	How was it Analyzed?
PEM Based Ungulate Winter Range	KBLUP UWR objectives were removed and the new habitat zones and associated cover constraints were implemented (see below for detail). *Application of forest cover requirements*: The modeled cover requirements were entirely consistent with the new UWR mapping and associated guidelines accept where retention was to be modeled around avalanche tracks (no data available). This meant that the areas designated as OR/OR in the PEM based mapping did not have any cover constraints applied. The area of Managed Forest in the PEM based mapping (63,350 ha of THLB) did have cover constraints applied (refer to Appendix B for detail). *Yields*: Yields and Analysis Unit Assignments remained unaltered from the base except future yields associated with Open Forest management were reduced by 50% to reflect lower minimum stocking requirements aimed at improving range habitat. The new UWR mapping specifies different locations and extents of OR/OF/MF areas relative to the base case and the yield implications of this were not captured in this sensitivity. If the PEM based designations for OR/OF were used to redo Analysis Unit assignments, the net result would be a 3714 ha increase in OR area and a 6084 ha increase in OF area. This includes shifts in area between the OR/OF/MF designations. As an example, the new UWR-OR currently consists of 8% OR, 66% OF, and 26% MF as designated in the base case. The new UWR-OF consists of 3% OR, 24% OF, 73% MF as designated in the base case. The new UWR-MF consists of 1% OR, 2% OF, and 97% MF as designated in the base case.
New Caribou	The KBLUP caribou objectives were removed and the new habitat zones and cover constraints were implemented. Leading tree species in combination with the mapped habitat zones defined the final constraint groups in FSSIM. Only 'Core' habitat areas and 'Intra-Population Connectivity" areas occur in the Invermere TSA.

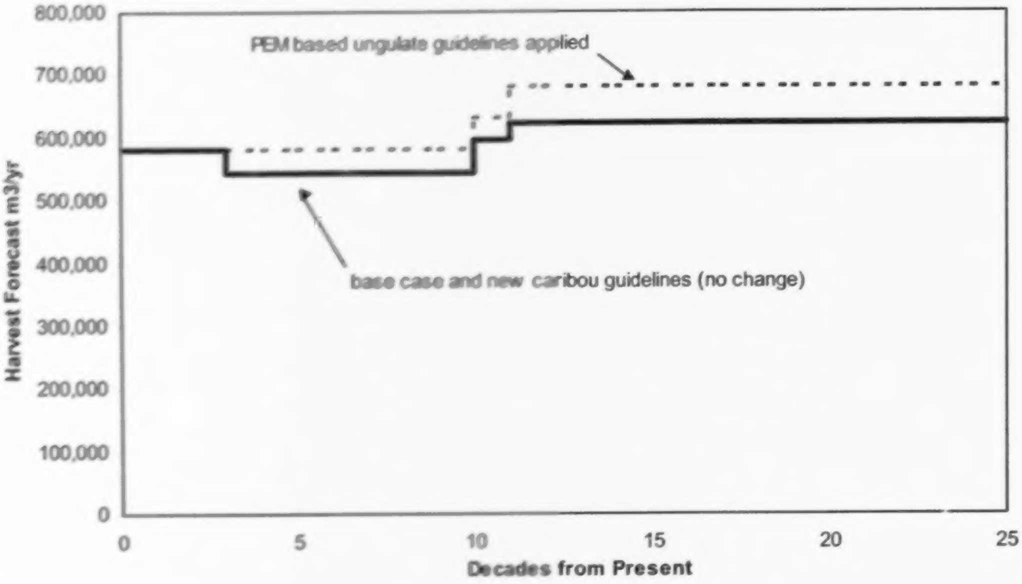


Figure 41. Application of New Ungulate Winter Range and Caribou Guidelines

Results

Run	Short Term	Mid Term	Long Term
New UWR Guidelines	No change.	Current AAC is maintainted through trough, 7.2% higher than the base case (581,570 m3/yr).	Increase in the long-term harvest level by 9.6% to 681,570 m3/yr.
New Caribou Guidelines	No change.	No change.	No change.

The new UWR management guidelines cover 4197 fewer THLB ha including open range and open forest areas. Forest cover requirements are significantly less constraining and have been completely eliminated in open range/open forest ecosystems in recognition that forage is more of a concern in these areas than snow interception. Thus 29,376 fewer CFLB ha (24% reduction) and 26,251 fewer THLB ha (29% reduction) have cover constraints applied compared to the base case. This has increased the flow of available timber through the mid-term and eliminated the trough. It has also increased the long-term harvest level by almost 10%. This projection slightly overestimates the long term harvest flow associated with the new UWR guidelines because the retention requirements around avalanche tracks were not modelled and the reduced yields associated with the proposed expansion of open range / open forest areas were not modelled. This is anticipated to reduce the long-term harvest level by 2-3% and have minimal impact in the short and mid term.

The new caribou guidelines had no affect on the base case harvest flow. The area modelled as caribou habitat in the Invermere base case is very small (11,095 ha of CFLB, 2,534 ha THLB). The new guidelines apply to less area (6664 ha of CFLB, 1225 ha of THLB) but completely exclude harvesting from 710 ha of the THLB area while lowering constraints in other areas. The reduction in area comes from the removal of Pl leading stands from the core habitat areas below the caribou line. The net change in timber availability is not enough to impact TSA level harvest flows.

6.10 OGMA/MMA Modeling

In the base case, spatially explicit Old Growth Management Areas and Mature Management Areas were used to meet landscape level objectives of old seral and mature forests for the first 80 years. A GIS exercise was used to select areas as OGMA's and MMA's (up to required target areas) based on a priority sequence derived by the MSRM planner in the East Kootenays (Tom Volkers). A spatially explicit approach to modeling the HLPO old and mature forest objectives in the base case was used because it allowed full recognition of connectivity requirements and the operational realities around pine beetle management in the TSA.

In all cases, no harvesting was permitted in these OGMA's and MMA's for the first 80 years. After 80 years, the spatial OGMA's and MMA's were no longer constrained, and were replaced with landscape unit and biogeoclimatic level constraints. This is intended to reflect the expectation that OGMA's and MMA's are not static over the planning horizon and can move to other suitable stands. The transition to seral goals was done at year 80 because it corresponded with an increase from one-third to two-thirds target requirements in Low Biodiversity Emphasis Option areas.

To examine the impact that spatially explict OGMA/MMA's may be having in this analysis, a sensitivity run was completed where no spatial OGMA/MMAs were used and seral constraints were applied from time zero. This run will help to answer the question of impact from connectivity requirements in the HLPO.

How was it Analyzed?

Run	How was it Analyzed?
Replace Spatially explicit OGMA's and MMA's with Seral Goals	Spatial OGMA's were ignored. A landscape unit/BEC level objective for old and mature seral retention (where required) was applied throughout the planning horizon. In low BEO areas, the requirement increased to 2/3 of the old seral target by 80 years, and to the full target by 160 years.

Results

Run	Short Term	Mid Term	Long Term
Replace Spatially explicit OGMA's and MMA's with Seral Goals	No change	No change	No change

There was no change in the harvest forecast as a result of replacing the spatial old and mature retention with seral constraints. The connectivity rules in the HLPO do force more retention into the THLB so an impact was expected. However, MSRM's OGMA/MMA allocation rules did not use pine leading stands in the THLB because of concerns with mountain pine beetle attack and this appears to have effectively offset any extra THLB retention required by connectivity rules in the HLPO

The most notable change in this sensitivity run was the mean harvest ages over time. Figure 42 shows the mean harvest ages over time for both the base case and the seral constraint sensitivity run. The sharp increase in harvest ages in the 9th decade, associated with 'releasing' the OGMA's in the base case, is not apparent in the sensitivity analysis. The harvest of these older stands is simply spread into earlier periods, raising the mean harvest age for the seral constraint run in these periods.

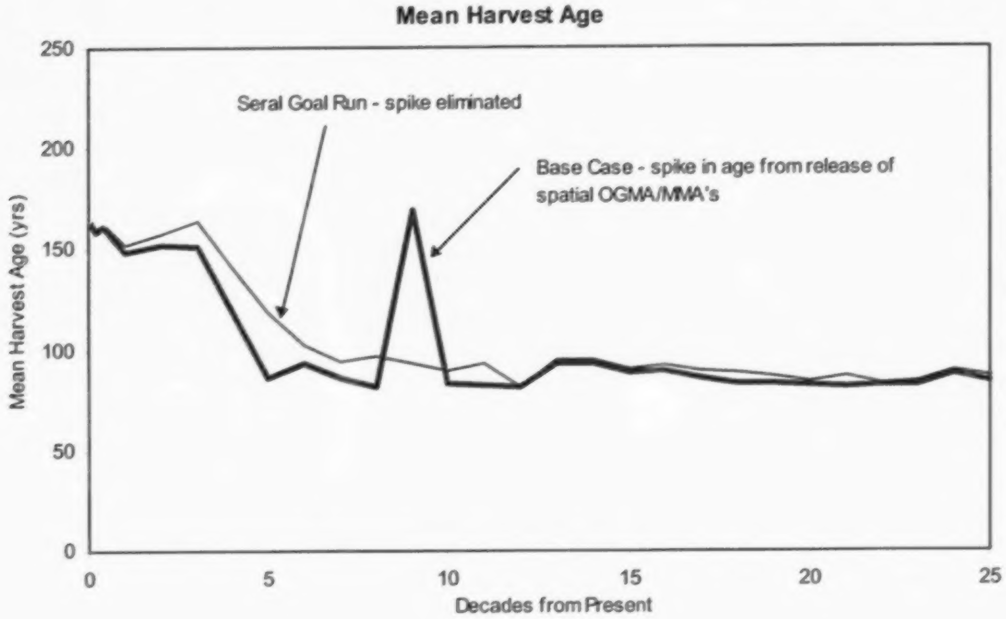


Figure 42 Mean harvest age when spatially explicit OGMA's and MMA not used in analysis

6.11 Kootenay National Park

The Kootenay National Park (KNP) was included in the TSR3 crown forested land base (CFLB) at the direction of Ken Gorsline (MSRM Regional Manager, Strategic Planning) and was allowed to contribute to forest cover objectives in the Shuswap-Windermere, Pedley, and Cross Landscape Units. Coarse forest cover mapping was available for approximately two thirds of the park area. Discussions between Parks Canada and MSRM are currently ongoing with the goal of assessing whether park management objectives are compatible with maintaining old growth objectives. There is currently no formal agreement with Parks Canada on the inclusion of KNP to meet biodiversity objectives, so a sensitivity analysis has been run to evaluate the impacts of removing it from the CFLB.

How was it Analyzed?

Run	How was it Analyzed?
KNP removed from the CFLB	The crown forested area of Shuswap-Windermere, Pedley, and Cross landscape units was reduced to reflect the exclusion of the KNP area. The spatial OGMA/MMAs in the KNP were not utilized and the amount of OGMA/MMA required in these three LU's was lowered to reflect the new CFLB area. The remaining spatial OGMA/MMA's were used and then transitioned into seral goals at age 80, just as in the base case.

Results

Run	Short Term	Mid Term	Long Term
KNP Removed	No change	No change	No change

The area of the KNP that is currently old and mature is roughly equivalent to the increase in OGMA/MMA target areas required in the expanded CFLB. In simple terms, the KNP is pulling its weight in terms of old/mature representation but it has little additional area to offer the TSA – thus the retention level remains similar in the TSA and the harvest flow remains unchanged.

6.12 Mountain Pine Beetle Infestation

The base case analysis includes a high harvest priority on young pine stands in order to emulate current practices around mountain pine beetle issues in the TSA. Current practices are attempting to control beetle populations and salvage mortality where it occurs. The 2003/4 beetle survey data show that populations are expanding quickly and could cause significantly mortality if they are not held in check by management practices and/or environmental factors. This sensitivity is designed to explore the implications of a large outbreak occurring and causing significant mortality in the TSA. The outbreak is assumed to kill 50% of the susceptible pine stands in the TSA in the next 10 years. Susceptible pine stands are consider to be >60 yrs old and not in the ESSF biogeoclimatic zone.

Pine-leading stands make up over 40.7% of the THLB in the TSA and susceptible pine stands make up 17.5% (40,925 ha) of the THLB. Thus, an area of 20,462 ha of susceptible pine stands are killed in the first 10 years of this sensitivity analysis. This results in a level of mortality beyond what licensees can salvage in a timely manner, and thus a significant volume of timber is lost.

How was it Analyzed?

Run	How was it Analyzed?
Mountain Pine Beetle Outbreak	After 1 decade in the harvest scenario (10 years from now), one half of all susceptible pine stands in the THLB (20,462 ha) are assumed to be beetle-killed and require salvage. This area was picked randomly from the susceptible stands and then placed on a separate set of analysis units with a high harvest priority applied. Salvage of these stands is allowed to continue for 10 years and any unsalvaged stands existing at the end of 20 years are transferred back to natural stand yield curves and all volume is lost. Salvaged stands have a 1 year regeneration delay, while unsalvaged stands have a 20-year regeneration delay. The amount of Pl harvested in any period was limited to 90% to reflect mill requirements. Constraints were left on and minimum harvest ages were left unchanged.

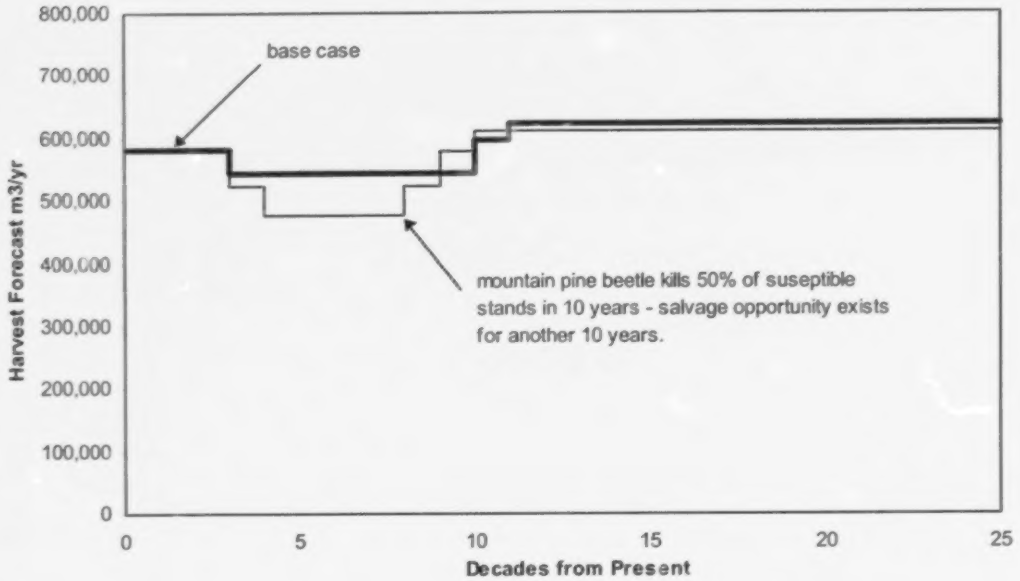


Figure 43. Mountain pine beetle outbreak

Results

Run	Short Term	Mid Term	Long Term
Mountain Pine Beetle Outbreak	No change.	Trough is shorter but deeper by 9.7% (524,570 m^3/yr)	Decreases by 1.6% to 611570 m3/yr.

During the 2nd decade, 14,378 ha of dead pine stands were salvaged, leaving 6,084ha (~1,343,000 m3) of dead pine stands unsalvaged. All of the area was not salvaged because minimum harvest ages for natural stands (80-130 yrs) and forest cover constraints limited availability. This unsalvaged area represents 2.6% of the timber harvesting land base and is naturally regenerated at 20 years into the forecast, creating an age class gap and decreasing the area of merchantable timber available. This lead to a deeper drop in harvest level in the 3rd decade and a lower trough (9.7%) than occurred in the base case. An aggravated pinch point in decade 17 resulted in a lower long term harvest level. An increased level of salvage during the second decade would not have altered the future harvest flow after period 2, but it would have captured more of the 1.3+ million m3 that was lost at the end of the 2nd decade. This run may not adequately capture the full risk associated with a large mountain pine beetle infestation because it poorly represents the losses of pine in stands where it is not the leading species. A large outbreak could impact more volume that was killed in this scenario.

6.13 Regeneration in 2003 Fires

The fires of 2003 impacted mostly non THLB area in the Invermere TSA but still resulted in a large-scale salvage effort in 2003/04. Within the THLB, a total of 1,985 ha were inside the mapped fire boundaries for Venebles, Middle Fork, and Magnesite fires. The other major fires in 2003 did not include any THLB area (Joffe, Hot, Bear). The base case salvaged merchantable timber within the fires for the first 2 years and assumed a 20% volume reduction in those stands. Over 1042 ha (221,720 m3) were salvaged in the base case, and regenerated as managed stands. The remaining unsalvaged stands in the fires were all regenerated to natural stand AU's and 10% of the fire areas were assumed to become unproductive.

There is uncertainty around the types of stands that will regenerate on the areas that are not salvaged logged. Licensees assume regeneration obligations for salvaged areas but the remaining areas are left to the crown to regenerate and will likely regenerate naturally. There is potential that a portion of these sites will experience repression and become problem forest types in the future without stand level intervention. This sensitivity explores the implications of 70% of the unsalvaged fire areas dropping out the THLB because they do not regenerate to merchantable stands.

How was it Analyzed?

Run	How was it Analyzed?
Regeneration of 2003 Fires	The TSR3 dataset includes 1,985 ha of THLB inside the fire boundaries. The base case salvaged 1,042 ha in the first two periods, leaving 943 ha unsalvaged. A portion (70%) of this area is to become unmerchantable (660 ha) and will no longer contribute to harvest, while 30% are regenerated as natural stands. This was implemented in the model by assigning all fire areas to a set of analysis units with a high harvest priority. At the end of 2 years, any area not salvaged was transferred to another set of analysis units where a 70% volume reduction was applied (surrogate for a 70% area reduction). These stands remained on these curves for the rest of the planning horizon.

Results

Run	Short Term	Mid Term	Long Term
Regeneration of 2003 Fires	No change	No change	The long term harvest decreases by 0.3% to 619,705 m3/yr.

The short term is unaffected because there is no loss of mature volume when these stands are removed from the THLB. The volume loss is already modelled in the base case and this sensitivity is only concerned with the amount of fire area that will regenerate to productive stands. Thus the loss of THLB would only be evident when the excluded sites would have contributed merchantable timber to the forecast (long term harvest flow). The area lost from the THLB (660 ha or 0.3%) is too small to have any discernible impact on long term harvest levels – although there is a small impact occurring.

6.14 Summary of Sensitivity Analyses

Table 6. Summary of Sensitivity Analysis Results

Run	% Change to Harvest Forecast Decade			
	1	2-3	4-8	9-25
Timber harvesting land base increased by 10%	-	+3%	+11%	+10%
Timber harvesting land base decreased by 10%	-	-19%	-13%	-11%
Natural Stand yield increased by 10%	-	+3%	+11%	-
Natural Stand yield decreased by 10%	-	-19%	-13%	-
Managed stand yield increased by 10%	-	-	+3%	+9%
Managed stand yield decreased by 10%	-	-10%	-10%	-10%
Open Range and Open Forest provide no yield	-	-	-4%	-
Open Forest Future Entry Yields decreased by 50%	-	-	-	-
Min Harvest Ages decreased by 10yrs	-	-	+2%	-3%
Min Harvest Ages increased by 10yrs	-	-19%	-17%	-
Random Harvest Priority	-	-	-4%	-3%
Relative Oldest First Priority	-	-	-	-
Increased Regeneration Delay	-	-	-1%	-3%
Select Seed gains from 2013	-	-	+2%	+3%
No Gains from Select Seed	-	-	-	-4%
Full SIBEC	-	-	-	-
New PEM UWR	-	-	+7%	+10%
New Caribou	-	-	-	-
Replace Spatially explicit OGMA's and MMA's with Seral Goals	-	-	-	-
Remove Kootenay National Park from the CFLB	-	-	-	-
Mountain Pine Beetle Outbreak	-	-	-10%	-2%
Regeneration of 2003 Fires	-	-	-	-0.3%

No sensitivity analyses impacted the harvest flow in the first decade of the planning horizon.

7.0 Socio-Economic Assessment

7.1 Introduction

To help inform the TSR3 process, this socio-economic assessment (SEA) estimates the likely economic activity associated with alternative timber supply scenarios. A region's timber supply is a fundamental determinant of the size of its forest industry, which is often a leading sector in BC regional economies. The Chief Forester determined allowable annual cut (AAC) effectively sets the upper limit on the annual timber supply available for harvest in a TSA. Changes to an AAC can have important economic consequences so gauging their likely impacts provides important decision making information for TSA stakeholders and the Chief Forester.

This socio-economic analysis compares the level of employment, employment income and government revenues that the current AAC can support with the levels that could be supported by the base case timber supply forecast. It also includes the following elements.

- Brief socio-economic profile of the TSA
- Brief profile of the TSA's forest industry
- Estimate of employment supported by recent harvesting in the TSA

7.2 Current socio-economic setting

7.2.1 Current population and demographic trends

The TSA has a relatively small population of about 9 000, dispersed amongst several settlements, such as Edgewater, Windermere, Canal Flats, Wilmer, and Parson, and one small town, Invermere. Its' only other incorporated municipality is the small village of Radium Hot Springs. The full-time resident population is augmented by a significant (but known number) of part-time residents (mainly from Alberta) at Panorama Mountain Village, Fairmont Hot Springs, Radium Hot Springs and Lake Windermere.

Cranbrook, 146 kilometers south of Invermere, is the regional service center. Columbia Lake Indian Band at Windermere and Shuswap Indian Band at Invermere have communities in the TSA with a total population of approximately 400. The former is part of the Ktunaxa First Nation and the latter is part of the Shuswap First Nation but is aligned with the Ktunaxa Kinbasket Tribal Council.

The TSA's population growth has maintained pace with the province-wide performance over the past two decades, but has slowed significantly in the last five-year period. The TSR2 socio-economic analysis projected an increase in population between 1996 and 2001 of 10.5%, instead it recorded a 0.7% decrease, due to contractions spread across a few sectors, forestry, tourism, agriculture and the public sector. The long-term population rise in the Invermere TSA (41.2% in last 20 years) is attributable to strong growth in its tourism sector, which includes Radium Hot Springs Resort, championship caliber golf courses, Panorama Mountain Ski Resort and several other attractions that bring in many visitors from Alberta.

The town of Invermere's population growth has exceeded the province-wide rate by several percentage points in each five-year period over the past 20 plus years. This tourism-focused community registered a population rise of more than 10% over the 1996-2001 period offsetting a decline in the rest of the TSA.

Table 7 presents population data for the TSA, Invermere and the province.

Table 7. Population 1981 - 2001

Areas	2001 Population	% change '01 over '96	% change '01 over '91	% change '01 over '81
Invermere TSA	9 165	- 0.7	25.6	41.2
Invermere	2 983[7]	11.0	35.2	47.8
BC	3 096 891	4.9	19.1	42.4

Source: BC Stats

7.2.2 Economic profile

Results from the 2001 Census indicate that the tourism employment sector was the largest in the TSA by a wide margin (33.9% in 2000)[8]. The public sector is no.2 with 21.3% of basic sector employment. However, tourism's importance drops precipitously when measured by employment income, as the sector's relatively low wages mean that it has only 15.7% of basic sector employment income, ranking in size below the forest industry, public sector, and those who rely on pension and investment income. There were small decreases in the amount of employment supported by the forestry, tourism, agriculture and the public sectors over the 1995-2000 period and a significant increase in the construction sector. The overall basic sector employment decrease by about 2% in this period. Table 8 gives the percentage share of employment by basic sector in 2000 and 1995 and the percentage share of employment income by basic sector for 2000. The 2000 basic sector data is the most current available - the current situation is not expected to be significantly different except for recent reductions in the public sector workforce.

Table 8. Basic Sector Employment and Employment Income Distribution (% share)

	Forest	Mining	Fish/ trap	Agri	Tour- ism	Hitech	Public sector	Const- ruction	Other basic	Trans- fers	ONEI[9]	Total[10]
2000 Employment income	18.9	1.9	0	0.8	15.7	0	18.7	13.8	0.7	13.5	15.9	100
2000 Employment	19.1	2.9	0	2.7	33.9	0	21.3	18.1	1.4	-	-	100
1995 Employment	19.7	2.9	0	3.7	35.3	0	21.7	14.1	2.6	-	-	100

Source: BC Stats

The TSA's forest sector vulnerability index of 20 (as calculated by BC Stats) is relatively low[11], indicating that its' forest industry, although important is but one of a few drivers of the regional economy. Its' diversity index (as calculated by BC Stats) is 73, amongst the highest of any TSA in the province, indicating an economy that is not tied to one or two sectors for its' wellbeing[12].

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[7] Invermere's 2003 population was estimated as 3 084, a 3.4% increase from its' 2001 level [BC Stats February 26, 2004b].

[8] "Basic sector" is the economics term for the collection of industries that draw revenue from outside the plan area. Non-basic sector is the term for the collection of businesses and organizations that rely on local spending, mainly retail and service businesses Basic industry revenue may arise from the selling of goods (e.g. lumber) or services (e.g. fishing lodge accommodation and guiding). Some industries have basic and non-basic characteristics and judgement is required in allocating between the sectors. The transportation industry is an example, with local long-haul truckers serving local businesses on an outgoing basis and serving outside parties with backhauls. Government services, from a TSA perspective, comprise a basic industry since public services do not directly depend on TSA tax payments and other government charges. The relative employment share shown in Table 8 for each basic sector industry includes the total of its direct, indirect and induced components.

[9] Other non-employment income (ONEI), mainly investment and pension income

[10] Totals do not add up to 100% due to rounding.

[11] This index is a relative one. Port Hardy is the most forest industry dependent in the province and therefore carries a vulnerability index rating of 100. Victoria is the least vulnerable and so carries an index rating of 0. TSAs and communities are ranked vis a vis the forest sector dependence of these two communities. For comparison, Cranbrook TSA has a forest vulnerability index of 14. The Quesnel TSA's forest vulnerability index is much higher at 81.

The relatively lower average incomes in the tourism sector are the reason for the drop in their economic importance when employment income is the focus. As well, tourism does less local purchasing than most other sectors and jobs with higher incomes can support more spending in local service and retail outlets. The next table presents employment incomes by major BC industries and shows that the forest and mining industries have the highest averages in the province. The BC logging industry average of $44 642 is 40.0% more than the all industries average of $31 899 and more than double the average income in the accommodation services sector.

Table 9. Average BC incomes and Invermere TSA employment multipliers

Industry	Income[13]	Indirect Multiplier	Indirect & Induced[14] Multiplier
Logging	$44 642	1.18	1.27
Saw milling	$42 555	1.29	1.43
Pulp manufacturing	$58 995	1.59	1.62
Coal mining	$55 176	1.31	1.39
Government services	$42 258	1.12	1.21
Accommodation services	$20 461	1.08[15]	1.13
All industries average	$31 899	-	-

Source: Statistics Canada and BC Stats

The indirect and induced spending of the resource extraction sectors in the Invermere TSA is also much higher than for other sectors, such as government and tourism. The previous table lists the indirect and combined indirect and induced multipliers for the Invermere TSA. The TSA's logging industry creates double the indirect and induced employment of its' tourism sector and the local saw milling creates almost three times the indirect and induced employment in the Invermere TSA as the tourism sector.

In 1996, the unemployment rate in the Kootenay Development Region was the same as the BC average, 8.7%. Over the intervening years, the Kootenay unemployment rate has increased substantially due to labour productivity improvements and economic upheavals in the region's large resource extraction industries, reaching 13.3% in February 2004. The BC unemployment rate has fluctuated within a narrow range over the same period. The following table compares the Kootenay Development Region and BC unemployment rates.

Table 10. Unemployment rates (%)

Region	1996	1997	1998	1999	2000	2001	2002	2003	2004
Kootenay	8.7	9.3	11.8	9.0	10.1	9.6	10.1	11.5	13.3
BC	8.7	8.4	8.8	8.3	7.2	7.7	8.5	8.1	7.6

Source: BC Stats

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[12] This index is based on relative dependence on a single sector. If an area was entirely dependent on one sector, its' diversity index would be 0. It would be 100, if the area was equally dependent on each defined sector. The BC diversity index numbers tend to range between 50 and 75, so the Invermere TSA can be characterized as highly diversified within the BC context.

[13] Sourced from 2001 Census, reported in 2000 Constant dollars

[14] Assumes no migration in the event of lay-off

[15] Indirect and indirect/induced multiplier refer to the overall tourism sector, which includes the accommodation industry

7.3 Invermere TSA Forest Industry

7.3.1 Current Allowable Annual Cut (AAC)

The Chief Forester set the current AAC of 581 570 m^3 effective September 2001, which is 9 930 m^3 (1.7%) lower than the previous AAC of 591 500 m^3 that became effective September 1996. This reduction was attributed to volume allocated to woodlot licenses since the 1996 determination.

Replaceable forest licenses account for 85% of the AAC apportionment. Tembec Industries Inc. (Tembec) has the TSA's largest commitment, 263 843 m^3, attached to its replaceable forest license, accounting for 45.4% of the AAC. Canadian Forest Products Ltd. (Canfor) has rights to 231 005 m^3 (39.7%) of the current AAC. Table 11 presents the current apportionment and commitments for the Invermere TSA.

Table 11. Invermere TSA AAC Apportionment and Commitments (m^3 & % of AAC)

Licensee by Form of Agreement	m^3	% of AAC
Forest Licenses Replaceable	494 848	85.1
Tembec Industries Inc.	*263 843*	*45.4*
Canadian Forest Products Ltd.	*231 005*	*39.7*
TSL<=10 000 m^3, replaceable	10 6[illegible]	1.8
North Star Planing Co. Ltd.	*7 505*	*1.3*
Clarence Palumbo	*1 372*	*0.2*
BCTS Timber Sale License/License to Cut	74 049	12.7
Forest Service Reserve	2 000	0.3
Total Allowable Annual Cut[16]	581 570	100.0

Source: Ministry of Forests, Revenue Tenures and Engineering Branch

BCTS has almost 13% of the current AAC. This share is expected to increase to about 20% when the "takeback" process[17] under the BC Government's Forestry Revitalization Plan is completed by the end of 2004. Discussions are underway between the TSA's major licensees and the BC Government about where they will cede Forest License volume.

In December 2003 the BC Government invited the Ktunaxa Kinbasket Development Corporation (KKDC) [18] to hold a non-replaceable forest license, having a total volume of 50 000 m^3, targeted at salvage of wildfire damaged timber in the Magnesite Creek area.

The BC Government has presented a forestry and revenue sharing agreement proposal to the Ktunaxa Kinbasket Tribal Council[19] but neither the KKTC nor its member First Nations have accepted the proposal at the time of this report's preparation. The member First Nations of the KKTC have been developing their forest sector infrastructure in the past few years. For example, each has a resources coordinator, the KKDC is working with Tembec and Canfor to award contracts to First Nations members, and the human resources division of the KKTC joined with several partners to deliver a college level integrated resource management program for several First Nation members.

7.3.2 Invermere TSA harvest history

The Invermere TSA's actual harvest has been consistently above its' AAC in recent years. The gap between harvest and AAC indicates a strong market demand for the TSA's timber, which arises from the area's relatively lower harvesting cost, continuing strong end use market demand in the US and large wood processing capacity in the TSA. The TSA's harvest to AAC ratio is an average of 121% for the 1999--2002 period. Table 12 summarizes the TSA's timber billed harvest volume over the four-year 1999-2002 period.

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[16] Conventional Timber comprises 100% of the TSA's AAC.

[17] The "takeback" is a reallocation of 20 per cent of logging rights from major licensees. Source: BC Ministry of Forests Backgrounder dated March 26, 2003, available at http://www.for.gov.bc.ca/mof/plan/timberreallocation.htm

[18] Acting as the agent of the Ktunaxa Kinbasket Tribal Council

[19] If a Ktunaxa Kinbasket forestry and revenue sharing agreement has the same structure as recently signed ones, then there will be a non-replaceable forest licence, annual revenue stream, and opportunity to apply for a forest licence.

Table 12. Invermere TSA Volume (m^3) Billed by Form of Agreement (1999-2002)[20]

Form of Agreement	1999	2000	2001	2002	3 yr. avg.	4 yr. avg.
Forest licence	590 533	565 018	493 702	531 817	530 179	637 470
BCTS/SBFEP	108 214	140 262	68 840	104 411	104 504	105 432
TSL	13 385	16 109	15 100	7 102	12 924	12 770
Other[21]	73 053	68 073	66 987	62 929	65 996	67 760
Total	785 185	789 462	644 629	706 259	713 603	713 488
AAC	591 500	591 500	591 500[22]	581 570	588 190	589 018
AAC variance Over / (under)[23]	193 685	197 962	53 129	124 689	125 413	124 470
% variance from AAC Over / (under)	32.7	33.5	9.0	21.4	21.3	21.1

Source: BC Ministry of Forests, Revenue Branch

TFL 14, held by Tembec is within the former Invermere Forest District's boundaries and lies to the northeast of the Invermere TSA. Its' AAC of 160 000 m^3 was set in May 2001 and is about 25% the size of the TSA's AAC. Timber harvest on private lands in the TSA is minor (~30,000m^3/yr) and is not included in this analysis.

7.3.3 Invermere TSA major licensees and processing facilities

Overview

Tembec Industries Inc. is the TSA's main forest industry actor; the company has rights to approximately half of the TSA's AAC and owns half of the TSA's wood processing capacity.

The annual timber fiber processing capacity of the TSA's mills, 1.3 million m^3, is approximately double the TSA's current AAC. Annual regional timber processing capacity[24] totals about 2.9 million m^3 and the regional AAC totals[25] approximately 2.3 million m^3, leaving a gap of 0.6 million m^3, which is mainly fed by private land harvests. Table 13 lists the TSA's wood processing facilities and their locations, main products and estimated annual output capacities.

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[20] Accurate data for 2003 TSA harvest volume for the complete year was not available at the time of this report's preparation in early 2004.

[21] Other includes licence to cut, right-of-way clearings, roads, trespasses and other miscellaneous harvests

[22] AAC was lowered to 581 570 m3 as of September 1, 2001.

[23] BC Government cut control policies have allowed licensees to harvest + or – 50% per year from their licensed volume and + or – 10% over a five-year cut control period. These provisions are intended to provide licensees with sufficient flexibility to adapt to changing market and climatic conditions. The minimum harvest requirement was eliminated as of November 2003.

[24] Invermere TSA – 1.3 million m^3; Cranbrook TSA – 1.1 million m^3; and Kootenay Lake TSA – 0.5 million m^3.

[25] Invermere TSA – 581 570 m^3; Cranbrook TSA – 871 000 m^3; Kootenay Lake TSA – 700 000 m^3; and TFL 14 – 160 000 m^3.

Table 13. Invermere TSA timber processing facilities (2002)

Timber Processing Facility	Location	Main Product	Est'd annual output capacity
Tembec Industries Inc.	Skookumchuk	Pulp	248 000 metric tonnes
Tembec Industries Inc.	Canal Flats	Lumber (dimension)	166 million bd ft
Canadian Forest Products Ltd.	Radium Hot Springs	Lumber (dimension)	185 million bd ft
Seel Forest Products Ltd.	Edgewater	Lumber (decking & lamination stock)	36 million bd ft
Mardis Forest Products Ltd.	Skookumchuk	Lumber (timber) & remanufacturing	NA
Ukass Logging Ltd.	Wilmer Creek	Lumber (timbers)	5 million bd ft
North Star Planing Co. Ltd.	Athalmer	Lumber (timbers)	6 million bd ft
Clarence Palumbo Sawmills Ltd.	Parson	Lumber	NA
Brisco Wood Preservers Ltd.	Brisco	Poles	19 000 pieces

Source: Survey of TSA timber processing facilities and BC Ministry of Forests, Economics and Trade Branch (June 2003) *Major Primary Timber Processing Facilities in British Columbia 2002.*

Tembec Industries Inc.

Temiscaming, Quebec headquartered Tembec is the largest forest industry employer in the TSA, having harvesting operations and a dimension lumber mill at Canal Flats and pulp mill at Skookumchuk. The average annual processing employment supported by wood fibre from all sources at these facilities over the 2001-2003 period was as follows: Canal Flats saw mill - 180 person years (PYs) and Skookumchuk pulp mill - 315 PYs.

Including harvesting, planning, administration, log hauling, road building, silviculture, sawmilling, planing and pulpmaking operations, Tembec generated an annual average of 245 PYs of forest industry employment involved with harvesting and processing its Invermere TSA Forest Licence timber over the 2001-2003 period[26].

These TSA operations formerly belonged to Crestbrook Forest Industries Ltd. (Crestbrook), which amalgamated with Tembec in 1999.

Tembec's Canal Flats makes 2x2 through 2x12 lumber mainly for the American housing market. This mill's estimated annual timber input capacity is 600 000 m^3. The volume attached to the company's replaceable forest license is 263 843 m^3, leading the company to rely on other sources, including BCTS sales and its' TFL 14 and Cranbrook and Kootenay Lake TSA licenses. The Canal Flats mill ships residual chips to the Skookumchuk pulp mill and trim blocks to the company's Value Added Center in Cranbrook.

The Skookumchuk pulp mill sits inside the Invermere TSA but is on the boundary line between the Invermere and Cranbrook TSAs. As a consequence, about 90% of its' employees reside in the Cranbrook area. Its' annual timber input capacity is listed as 580 000 BDUs (or 205 300 m^3). About 40% of its' wood fiber comes from Invermere region sources. The following table presents recent harvesting and employment results for Tembec in the Invermere TSA.

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[26] This figure is based on employment involved with processing timber. Tembec's Value Added Centre in Cranbrook averaged employment of 46 PYs for 2001 and 2003. It sourced trim blocks from the company's Elko and Canal Flats mills and its Cranbrook planer mill.

Table 14. Tembec annual average harvests and employment, 2001-2003

Tembec Harvest / Employment	**Result**
Harvest	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	263 843
Annual average harvest, 2001-2003	262 115
2003 harvest	218 016
Employment	**Person-Years (PYs)**
Harvesting, planning & administration	90
Log transport	9
Road construction & maintenance	12
Silviculture	9
Timber processing	125
Total	245

Source: Ministry of Forests, survey of licensees and author's calculations

Canadian Forest Products Ltd.

Vancouver, BC headquartered Canadian Forest Products Ltd. (Canfor) is the second leading forest industry employer in the TSA as a result of purchasing Slocan Forest Products Ltd in early 2004. Including harvesting, planning, administration, log hauling, road building, silviculture, sawmilling, planing and pulpmaking operations, Canfor generated an annual average of 183 PYs of forest industry employment involved with harvesting and processing its' Invermere TSA Forest License timber over the 2001-2003 period.

The company has a dimension lumber mill in Radium Hot Springs, having an estimated annual fiber requirement at full capacity of 715 000 m^3. The volume attached to the company's replaceable forest license is 231 005 m^3, leading the company to rely on other sources, including private lands, Alberta, BCTS sales and its' Golden TSA license. The Radium Hot Springs mill ships residual chips and hog fuel to the Skookumchuk pulp mill, trim blocks to the company's fingerjointing Uneeda Division in Chilliwack, and shavings to Nova Fibre in Grand Forks. The mill produces dimension lumber, mainly for the American market, but also makes Japanese grade lumber, about 25% of its' output. Slocan (now Canfor) installed a new kiln and breakdown line at this mill in 2002.

The following table presents recent harvesting and employment results for Canfor in the Invermere TSA.

Table 15. Canadian Forest Products annual average harvests and employment, Invermere TSA 2001-2003

	Result
Harvest	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	231 005
Annual average harvest, 2001-2003	270 000
2003 harvest	326 000
Employment	**Person-Years (PYs)**
Harvesting	49
Log transport	10
Road construction & maintenance	5
Silviculture	7
Timber processing	112
Total	183

Source: Ministry of Forests, survey of licensees and author's calculations

BC Timber Sales (BCTS)

BCTS has about 13% of the TSA's AAC, 74 049 m^3. This figure may move up to the 20% level when the "takeback" process is concluded. The BCTS harvest averaged 104 505 m^3 over the past three years. The estimated average annual employment supported by the harvest and processing of BCTS timber is 80 PYs[27] for the 2001-2003 period. BCTS registrants who reside in the TSA account for an estimated 90% the BCTS harvest.

The following table presents recent harvesting and employment results for BCTS.

Table 16. BCTS annual average harvests and employment, 2001-2003

	Result
Harvest	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	74 049
Annual average harvest, 2001-2003	104 505
2003 harvest	104 411
Employment	**Person-Years (PYs)**
Harvesting, planning & administration, log transport, and road construction & maintenance	31
Silviculture	3
Timber processing	46
Total	80

Source: Ministry of Forests, survey of licensees and author's calculations

Other TSA Timber Processors

Seel Forest Products Ltd. is the TSA's third largest wood processing operation, having a head rig sawmill located in Edgewater. The family owned venture started approximately 55 years ago with a portable sawmill and in 1969 the owners started to construct a permanent mill. It annually produces about 12-14 million bd. ft. and consumes about 68-70 000 m^3 of timber purchased from private landowners and through BCTS sales. Seel has approximately 30-35 full-time mill employees and 5-7 employees in logging. The company mainly makes decking and lamination stock from fir and pine.

North Star Planing Co. Ltd. has a small head rig sawmill connected to a local building supply and hardware outlet in Athalmer. It has a replaceable Timber Sale Licence with a volume of 7 505 m^3 and contracts out its' harvesting to Tembec and Canfor, to acquire fir for making timbers, mainly, along with some dimension lumber. The sawmill requires 3-4 part-time employees. The company processes approximately 15-18 000 m^3 of timber annually.

Mardis Forest Products has a small band mill adjacent to the Skookumchuk pulp mill. Having four full-time employees, it is mainly a secondary manufacturing operation at this juncture, making kiln strips and dunnage. It also does some custom sawing and manufacturing of flooring, timbers and pine panels. The timber processing part of its' operation consumes about 1 000 m^3 of timber annually.

Clarence Palumbo has a replaceable Timber Sale Licence with a volume of 1 372 m^3. His family has a small circular saw and planning operation at Parson, which started in 1952. They make timbers and dimension lumber, some for the Japanese market, and source timber from 300 acres of their private land as well as the TSL volume. The mill is operated intermittently and processes about 3-5 000 m^3 of timber annually, making about 100 000 bd ft.

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[27] To construct this estimate, the BCTS harvest was multiplied by the forest industry employment coefficients (PYs per '000 m^3) of the TSA's licensees.

Ukass Logging Ltd. at Wilmer Creek has a small portable "bush" mill on a slab on its private land. The family owned operation makes timbers for the local market from timber harvested from their private land and Woodlot Licence. They process about 750 – 800 m^3 of logs per year.

Anecdotal reports indicate that there are several small operators with portable Wood-Mizer mills that process small amounts of larger pine and fir logs.

7.3.4 Forest sector employment and employment coefficients

The average annual total direct forest industry employment supported by Invermere TSA harvested timber over the 2000-2002 period is 389 PYs in the TSA and 549 PYs province-wide. On a province-wide basis, the TSA's annual harvest supported total[28] employment of approximately 1 200 PYs in recent years.

Table 17 presents estimates of annual employment supported by the 2001-2003 Invermere TSA harvest broken down by forest industry activity. Employment is reported as an annual average and as the intensity of employment per '000 m^3 of harvested timber. The latter figure is used to calculate potential employment impacts of alternative timber supply scenarios. The average employment levels and coefficients are reported at TSA and provincial levels[29].

Table 17. Invermere TSA timber supported employment and employment coefficients (2001-2003)

Activity	**TSA**		**Province**	
	Employment (PYs)	**Employment Coefficient (PYs/'000 m^3)**	**Employment (PYs)**	**Employment Coefficient (PYs/'000 m^3)**
Direct employment				
Harvesting[30]	164	0.23	214	0.30
Silviculture[31]	11	0.015	21	0.03
Timber processing[32]	214	0.30	314	0.44
Total direct employment	389	0.545	549	0.77
Indirect/induced employment	141	0.20	612	0.86
Total employment	530	0.745	1 161	1.63

Source: survey of licensee's and author's calculations

An estimated 85% of persons engaged in harvesting reside in the TSA. The majority of the harvesting occurs from June through March, stopping in the spring because of poor ground conditions. Conventional ground-based skidder harvesting systems are the most common, accounting for about two-thirds of the TSA's logging, but there has been more cable (about 30%) and helicopter logging (about 2%) in recent years.

Invermere TSA licensees are responsible for basic silviculture (i.e. establishment of a free-growing stand) on areas harvested under major licenses. BC Ministry of Forests is responsible for silviculture on areas harvested by BCTS award holders and on backlog not satisfactorily restocked (NSR) areas. The silviculture direct employment coefficient is listed as 0.03 PYs per '000 m^3 of harvested timber. This figure is an approximation of annual activity as silviculture work in any one year is not directly tied to the harvest of that year. If an area is harvested in the early summer, planning and site preparation work will often occur in the fall and planting in the following spring.

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[28] Total employment is comprised of direct, indirect and induced employment. Direct employment estimates come from a survey of licensees. Indirect and induced employment estimates are calculated with the aid of multipliers developed by BC Stats, which uses its input/output model and 2001 census results to estimate local and provincial multipliers. For more explanation about the estimates see Appendix G - *Socio-Economic Analysis Background Information.*

[29] TSA level is defined as residents of the Invermere TSA who are employed in the forest industry and its indirect and induced sectors. Provincial level is defined as all forest sector employment in the BC that relies on the Invermere TSA harvest, including both residents of the TSA and those who live elsewhere in the province.

[30] Includes harvesting, log transportation, log salvage, log scaling and harvest planning and administration

[31] Includes site preparation, planting, spacing, fertilization, pruning and silviculture planning

[32] Includes management, administration as well as facility operations

The per cubic meter employment attached to the Invermere TSA harvest has declined over the past decade as a result of declining employment in processing. In the early 90s, process employment intensity was estimated as 0.54 PYs/'000 m^3. In the 2001-03 period, it is about 20% lower, 0.44 PYs/'000 m^3.

The forest sector employment estimates do not include BC Ministry of Forests (MOF) employment in the TSA[33]. Invermere TSA, along with Cranbrook TSA, is part of the Rocky Mountain Forest District, and its' District Office is located in Cranbrook and had 38 FTEs as of December 2003. BCTS' Cranbrook office had 7 FTEs as of December 2003. There is a now only a field office in Invermere with 8.75 FTEs, whereas it previous had 50-55 employees [BC Ministry of Forests 1999].

7.3.5 Forest sector employment income

On a province-wide basis, in recent years, the Invermere TSA harvest supported an estimated average annual total employment income of $45 million ($62 800 per harvested m^3); $25 million ($35 400 per harvested m^3) of direct forest industry employment income and $20 million ($27 300 per harvested m^3) of indirect and induced employment income. The employment income contribution of the forest industry is high in part because of the industry's relatively higher income levels (listed in Section 7.2.2).

Table 18. Invermere TSA timber supported employment income and employment income coefficients (2000-2002)

Activity	Employment (PYs)	Est'd annual income per worker ($)	Total employment income[34] ($million)	Employment income coefficient ($/'000 m^3)
Direct employment				
Harvesting & forestry services	225	44 642	10.51	14 728
Solid wood processing	228	42 555	9.72	13 621
Pulp & paper processing	86	58 995	5.05	7 076
Sub-total direct employment	549		25.28	35 426
Indirect/induced employment	612	31 899	19.51	27 340
Total employment	1 161		44.79	62 766

Source: survey of licensees and author's calculations

7.3.6 Provincial government revenues

Altogether, the BC Government is estimated to have annually collected revenues of about $23 million ($32 200 per harvested m^3) on average over the 2000-2002 period from the TSA's harvest. There are three main sources of BC Government revenues from the forest sector as follows.

- *Stumpage* – which is a type of royalty paid for the right to harvest and use Crown-owned timber. The stumpage calculation method is in transition at this juncture from the Comparative Value Pricing System (CVP)[35] to a Market Pricing System (MPS). The new MPS went into effect for BC coastal timber on February 29, 2004 and is scheduled to go into effect for BC Interior timber by the end of 2004. An estimate of 2004 MPS stumpage in Cranbrook TSA is not available at this juncture. The average 2001-2003 Invermere TSA stumpage was \$15.99/ m^3 and the average 2003 stumpage was \$10.58/m^3.

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[33] Ministry of Forests employment is not included as part of direct forest industry employment because it is related to administration and statutory requirements and not to timber harvest levels and would not be affected by marginal timber supply changes. MOF employees are accounted for in the public service sector employment estimates reported in Section 7.2.2.

[34] Province-wide basis

[35] Adopted in 1987

- _Other forest industry taxes_ – This category includes logging taxes, corporate income taxes, property taxes, export fee in lieu of manufacture against exported logs, gas tax, sales taxes and Workers Compensation Board premiums paid by forest industry employers. The estimate of other forest industry taxes[36] is a unit cost total[37] of \$11.42 per harvested m^3. It should be interpreted as a very gross estimate because it includes several tax items that often change on a year-to-year basis.
- _Provincial income taxes and sales taxes_ – Forest industry employees and employees in the industry's indirect and induced sectors pay sales taxes on their personal purchases and provincial income taxes.

Table 19 shows estimates of recent average annual BC Government revenues derived from the Invermere TSA timber harvest.

Table 19. Average annual BC Government revenues derived from the Invermere TSA timber harvest, 2000-2002

BC Government revenue source	Est'd avg. annual revenues (\$million)	BC Govt. revenue coefficient(\$/'000 m^3)
Stumpage	10.1	14 154
Other forest industry taxes	8.1	11 351
Employment income & employee sales taxes	4.8	6 726
Total revenues	23.0	32 231

7.4 Socio-economic implications of the base case harvest forecast

7.4.1 Introduction

The socio-economic analysis focuses on harvest level changes in the short- to medium-terms (0 – 30 years). Economic impacts are gauged by comparing economic activity that could be supported by the current AAC with activity that could be supported by the base case harvest forecast. Although actual harvest levels drive economic impacts, they track the AAC level in the Invermere TSA so estimates based on AAC timber volume are valid expressions of future forest industry activity in this TSA.

The harvest level for the initial three decades of the TSR3 base case harvest forecast is 581 570 m^3, the same as the TSA's AAC, effective September 1, 2001. The TSR3 base case harvest forecast has a long term harvest level of 621 570 m^3, which is reached in the 11th decade. There is a drop to 542 570 m^3 in the TSR3 forecast, starting in its' fourth decade.

The TSR2 and TSR3 base case harvest forecasts diverge after the first decade. The base case harvest forecast for TSR2 had the current AAC in place for one decade and then steps down 58 157 m^3 in the second decade, 52 342 m^3 in the third decade and 44 190 m^3 in the fourth decade, whereupon a long term harvest level of 426 881 m^3 is reached.

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[36] Unit costs for each tax item were obtained from PriceWaterhouseCoopers (2000) *The Forest Industry in British Columbia* 1999.

[37] Removing Workers Compensation Board premiums reduces the unit tax cost to \$6.95 per m^3.

7.4.2 Short- and medium-term implications of alternative harvest levels

There are no differences in economic activity between the base case forecast and current AAC over the first three decades.

The base case harvest forecast of 581 570 m^3 (which extends for three decades) could annually support the following economic activity.

- estimated 433 PYs of total employment and $17.6 million of employment income in the Invermere TSA,
- estimated 948 PYs of total employment and $36.5 million of employment income in the province, and
- estimated $8.2 million of stumpage revenues and $18.7 million of total BC Government revenues.

The TSR2 base case harvest forecast is no longer current but the following table demonstrates the positive economic implications of the TSR3 base case forecast compared to the TSR2 one. The first decade of each forecast has the same economic impacts but thereafter they diverge. In the TSR2's second decade there are an estimated 46 fewer PYs of annual forest industry employment, a 10% difference. BC Government revenues are $2 million lower in the TSR2 base case forecast.

Table 20. Comparison of TSR3 and TSR2 base harvest forecast economic impacts

Decade	Timber supply (m^3)			Province-wide direct forest industry employment (PYs)			BC government revenues ($ million)		
	TSR3	TSR2	change	TSR3	TSR2	change	TSR3	TSR2	change
Decade 1	581 570	581 570	0	448	448	0	18.7	18.7	0
Decade 2	581 570	523 400	58 170	448	403	45	18.7	16.9	1.8
Decade 3	581 570	471 100	110 470	448	363	85	18.7	15.2	3.5
Decade 4	542 570	426 900	115 670	418	329	89	17.5	13.8	3.7

7.4.3 Requirements of BC timber processing facilities

No reduction in the AAC over the next three decades is positive news for timber processing facilities that rely on Invermere TSA wood fiber. The stability may be a positive contributing factor in decisions about making capital investments in current timber processing facilities.

7.4.4 Invermere TSA level impacts

There will be neither positive nor negative impacts for the regional economy unless the aforementioned AAC stability contributes to decisions about capital investments in processing capability. In the future, small reductions in the AAC as seen in the base case forecast would slightly reduce the available annual timber supply but would not register a negative impact on the regional economy for the following reasons.

Invermere TSA economy is relatively diversified[38] so minor changes in its' forest sector do not have significant consequences for its overall economic wellbeing. For example, the 39 000 m^3 stepdown projected in the fourth decade of the base case harvest forecast would place only 21 PYs of direct forest industry and 29 PYs of total employment at risk, 3.0% of the TSA's forest sector basic employment and 0.7% of the TSA's overall basic sector employment. The likely impact would be smaller because processing employment would not be reduced with this small change in AAC. Processors would likely acquire timber from other sources to compensate for a 39 000 m^3 reduction.

The proposed changes would not lead to a reduction in processing capacity.

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[38] Economies with greater dependence on their forest sectors are at greater risk when local timber supplies are reduced. As cited in Section 7.2.2, the diversity of the TSA's economy, as measured by BC Stats diversity index, is high.

BC Government cut control policies allow licensees to respond to market conditions so there is an allowance to harvest above a licence's volume in the short-term.

7.4.5 Regional timber supply implications

The Invermere TSA harvest appears to be fully directed to Invermere TSA timber processors, who rely on Golden and Cranbrook TSA, TFL 14 and private land sources for about 40% of their timber consumption needs. Stability in the Invermere TSA will contribute to regional timber supply stability. However, there is a significant reliance by timber processors within the Invermere, Cranbrook and Kootenay Lake TSAs on sourcing private land, Alberta, TFL and other TSA timber to meet their wood fiber consumption requirements.

7.4.6 Summary Table

Estimated employment, employment income and BC Government revenue impacts based on harvesting the base case harvest forecast (and September 2001 AAC) appears in Table 21.

Table 21. Estimated socio-economic impacts of implementing the base case harvest forecast

	Base case harvest forecast & Current AAC
Harvesting activity	(m^3)
Timber supply	581 570
Invermere TSA	
Employment	PYs
Direct	317
Indirect/induced	116
Total	433
Employment income	$ millions
Direct	13.9
Indirect/induced	3.7
Total	17.6
Province[39]	
Employment	PYs
Direct	448
Indirect/induced	500
Total	948
Employment income	$ millions
Direct	20.6
Indirect/induced	15.9
Total	36.5
BC Government revenues	$ millions
Stumpage	8.2
Other forest industry taxes	6.6
Employee income and sales taxes	3.9
Total	18.7

7.5 Summary

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[39] Provincial estimates include Invermere TSA estimates

Invermere TSA enjoys a highly diversified economy in the BC context, although its' tourism sector accounts for a dominant share of basic sector employment, about one-third. The small full-time resident population of approximately 9 000 is augmented by a significant number (~40,000) of part-time residents (mainly from Alberta) at Panorama Mountain Village, Fairmont Hot Springs, Radium Hot Springs and Lake Windermere. The tourism attractions include the Radium and Fairmont hot springs, Kootenay National Park, Intrawest's Panorama Mountain ski resort, heli-skiing in the Purcell Mountains and several resort layout golf courses, to name a few.

The forest industry is the major resource extraction sector in the TSA. Tembec Industries and Canadian Forest Products are the two major Forest License holders and account for 85% of the apportioned AAC of 581 570 m^3, effective September 2001. The TSA's four major timber processors annually consume about 1.3 million m^3 of wood fibre. Tembec operates a saw mill at Canal Flats, Canfor has one at Radium Hot Springs, as does Seel Lumber at Edgewater and Tembec has a pulp mill at Skookumchuk. The pulp mill sits on the border of the Invermere and Cranbrook TSAs, so the vast majority of its employees, about 90% live in the Cranbrook area.

The Knutaxa Kinbasket Tribal Council and/or its members in the TSA (Columbia Lake Indian Band and Shuswap Indian Band) may gain an Invermere TSA tenure upon completion of discussions about a forestry and revenue sharing agreement with the BC Government.

The base case timber supply forecast is 581 570 m^3 for the initial three decades, stepping down by 39 000 m^3 to 542 570 m^3 in the fourth decade.

This base case harvest forecast for the first three decades is the same as the current AAC set in September 2001. The base case harvest forecast of 581 570 m^3 (which extends for three decades) could annually support the following economic activity.

- estimated 433 PYs of total employment and $17.6 million of employment income in the Invermere TSA
- estimated 948 PYs of total employment and $36.5 million of employment income in the province
- estimated $8.2 million of stumpage revenues and $18.7 million of total BC Government revenues

Since the base case harvest forecast and the current AAC are the same for several decades, there will be neither positive nor negative impacts for the regional economy unless the AAC stability contributes to decisions about capital investments in processing capability.

In general, small changes in AAC would reduce the available annual timber supply but would not register a negative impact on the economy because the Invermere TSA economy is relatively diversified. Minor changes in the regional forest sector do not have significant consequences for the TSA's overall economic wellbeing.

8.0 Conclusions and Recommendations

This analysis report presents a harvest flow with a stable short-term timber supply. Given the inputs and assumptions in the base case, the current AAC can be maintained for 3 decades before declining 6.7% to the mid-term harvest level in the 4th decade. The long-term harvest level of 621,570 cubic meters is achieved by the 11th decade and is almost 7% above the current AAC.

The amount of timber available for harvest in decades 4 and 10 define the transition from the current AAC to the midterm harvest level and the length of the mid term trough. These periods represent pinch points in the analysis where little timber is available beyond what is harvested in the base case forecast. The current age class structure of the forest is a major influence on timber availability in these periods. The current lack of 30-60 year old stands in the THLB means the harvest level must temporarilly adjust to accommodate fewer merchantable stands coming online in 40 to 70 years. A steady long term harvest flow is possible once the age class structure on the THLB has become more evenly distributed.

The forest cover requirements associated with non-timber objectives also play a role in shaping the base case harvest flow. Cover requirements interact with age class structure to limit the availability of timber over the planning horizon. Without requirements to limit disturbance and/or maintain older stands on the land base, more timber would be available for harvest in the pinch points. Requirements for UWR and old seral goals are having the largest impacts on the base case harvest forecast, while VQOs, mature seral goals, and caribou constraints are influential but less constraining at the TSA level. IRM and watersheds constraints appear to be the least constraining on the harvest forecast.

The long-term harvest flow is now projected to be above the current AAC and is strongly influenced by several key factors. The use of select seed for regeneration and increased site productivity estimates have significantly improved long term yields relative to baseline managed stand yields.

In order to assess the impacts of potential changes to modeling assumptions, and gain further understanding of the dynamics at work in the base case forecast, a series of sensitivity analyses were completed.

Uncertainties that altered the short-term harvest level were:

- changes to the size of the timber harvesting land base,
- changes to existing natural stand yields, and
- increases in the time it takes regenerated stands to become merchantable (minimum harvest ages).

Uncertainties that altered the long-term harvest level by at least 3% were:

- changes to the size of the timber harvesting land base,
- changes to future managed stand yields,
- changes to the length of time it takes regenerated stands to become merchantable (minimum harvest ages and regeneration delays),
- the rate at which slow growing older stands are converted to more productive managed stands,
- management guidelines for ungulate winter range, and
- the amount of select seed used and its genetic worth.

Although these sensitivities indicate that there is potential for the harvest forecast to change, the base case scenario is felt to best represent the current situation in the Invermere TSA. Looking forward, it is highly probable that a number of sensitivities will soon represent 'current management' and improve timber supply in the mid- and long-term. These include new ungulate winter range guidelines and improved gains on select seed. New caribou guidelines will also soon be implemented but they did not influence timber supply in the Invermere TSA. It should be noted that none of the sensitivities examined for the TSA required an immediate reduction in the harvest level.

The following factors were not captured or adequately addressed in the base case analysis and warrant discussion.

1. The provincial Identified Wildlife Management Strategy is may reduce harvest levels by up to 1% in the future. Since the establishment of WHA's has been very slow to date, with few being established in the TSA, a 1% reduction has not been included in this base case.
2. The in-block retention study results used in this analysis addressed the yield implications of stand level retention (single trees, clumps, or patches) by evaluating the loss of volume at time of harvest and loss of site occupancy into the future. However, neither the study, nor the base case model addressed the potential for reduced regeneration performance in the harvested openings around retained stems (shading).
3. The in-block retention study provided a volume reduction percentage to be applied to all clearcut analysis units. This reduction addressed both WTPs and other forms of in-block retention. This lead to double counting because existing WTP's were netted out of the land base. If the WTP's were not netted out of the THLB, it would be 637 ha (0.3%) larger.
4. The 1996 Inventory audit showed inventory volume estimates were low by 3.4%. This was not included in the analysis because the 3.4% was not considered statistically significant.
5. The volume of wood salvaged from the 2003 fires in the model was only about 2/3 of what licensees estimate they will salvage. This is likely due to the difference between minimum harvest ages in the model and what is harvested in the field. The base case is not realizing 104,000 m3 (326,000 est – 221,720 actual) of salvage in the first several years of the forecast and it is lost when these stands regenerate at the end of year 3.

Improving upon the base information and assumptions used in this analysis, will allow the next timber supply analysis to provide for improved estimates of harvest flow. Some recommendations for future work to be completed before the next analysis are provided below:

- Complete a VRI Ground Sampling project for the TSA. The most recent inventory audit identified that the yields from natural stands may be under-estimated by 3.4%. The short-term to mid term harvest is very dependent upon the yields from natural stands.
- Better define the impacts of root rots on stands yields. Operational Adjustment Factors (OAFs) have been used to represent the yield impact of root rots on fir and pine stands, however more knowledge on how root rots effect yields, as well as the extent of the disease, will improve the certainty of this factor.
- Improve the estimate of area lost to roads, trails and landings. In TSR3, the sum of the existing and future reductions for road, trails and landings is 21,775 ha or 9.1% of the entire timber harvesting land base. This is a high percentage when compared to other management units in the province and is partially based on pre Forest Practices Code data. Improving or updating the estimate of roads, trails and landings will directly effect the size of the THLB.
- Completing the establishment of wildlife habitat areas in the TSA will increase certainty of the size of land base available for timber harvesting.

Appendix A – Acronyms

AAC	Allowable Annual Cut
Analysis	Timber Supply Analysis
AU	Analysis Unit
BCTS	BC Timber Sales (Formerly Small Business Forest Enterprise Program)
BEC	Biogeoclimatic Ecosystem Classification
BEO	Biodiversity Emphasis Options
BGB	Biodiversity Guidebook
BL	Balsam Fir
CF	Chief Forester
CFLB	Crown Forested Land base
CORE	Commission on Resources and Environment
CW	Western Red Cedar
DBH	Diameter at breast height (1.3m)
DEO	Designated Environment Official
DFO	Department of Fisheries and Oceans
DM	District Manager
ESA	Environmentally Sensitive Area
FD	Douglas Fir
FES	Forest Ecosystem Specialist
FIP/FC1	Old Forest Cover Digital Files
FMER	Fire Maintained Ecosystem Restoration
FIZ	Forest Inventory Zone
FPC	Forest Practices Code
FRBC	Forest Renewal British Columbia
FSSIM	Forest Service Simulation Model
GIS	Geographic Information System
HLPO	Higher Level Plan Order
HW	Western Hemlock
IWAPS	Interior Watershed Assessment Procedure System
KBLUP-IS	Kootenay Boundary Land Use Plan – Implementation Strategy
KBHLPO	Kootenay Boundary Higher Level Plan Order
LA	Alpine Larch
LRMP	Local Resource Management Plan
LTHL	Long Term Harvest Level
LU	Landscape Unit
LW	Western Larch
MoF	Ministry of Forests
MSRM	Ministry of Sustainable Resource Management
MSY	Maximum Sustained Yield
MSYT	Managed Stand Yield Tables
MWLAP	Ministry of Water, Land and Air Protection
NCC	Non-Commercial Cover
NDT	Natural Disturbance Type
NP	Non Productive
NRL	Non-Recoverable Losses
NSR	Not Satisfactorily Restocked
NSYT	Natural Stand Yield Tables
OAF	Operational Adjustment Factor
OGMA	Old-Growth Management Areas
PA	Whitebark Pine
PEM	Predictive Ecosystem Mapping
PL	Lodgepole Pine
PSP	Permanent Sample Plot
PSYU	Public Sustained Yield Unit
PW	White Pine
PY	Ponderosa Pine (tree species) or person years (economics)
RIC	Resources Inventory Commission
RM	Regional Manager
RMZ	Riparian Management Zone
ROS	Recreation Opportunity Spectrum
RTEB	Resource Tenures and Engineering Branch
THLB	Timber Harvesting Land base
TIPSY	Table Interpolation Program for Stand Yields (growth and yield model)
TSA	Timber Supply Area
TSR	Timber Supply Review
UREP	Use, Recreation, and Enjoyment of Public
VDYP	Variable Density Yield Predictor (growth and yield model)
VEG Ht	Visually Effective Greenup Hieght
VQO	Visual Quality Objective

Appendix B – Data Inputs and Modeling Assumptions

Changes from the March 8th, 2004 Data Package v3.0 (Approved March 19th)

- WTP's and in-block retention are now addressed using a 3.5% volume reduction on all clearcut yields curves (not open range or open forest). This value was determined in a in-block retention study completed by Forsite in March 2004. The study was based on just over 2000 ha of cutblocks (42 SP's).

- A base case caribou cover constraint was increased. The ESSF below Caribou line constraint was increased from 30%>140 to 40%>140 to compensate for partial cutting restrictions on an additional 20% of this zone.

1.1 Purpose of the data package

The purpose of this data package is to:

- provide a detailed account of the land base, growth and yield, and management assumptions related to timber supply that the chief forester must consider under the *Forest Act* when determining an allowable annual cut (AAC) for the Invermere TSA and how these will be applied and modeled in the timber supply analysis;

- provide the evidentiary basis for the information used in the analysis;

1.2 Forest Cover Inventory

The forest cover inventory was a key component to the timber supply review of the TSA. The history of the forest cover inventory in the Invermere TSA can be summarized briefly as:

- The most recent forest cover inventory for the TSA was completed in 1995. Since then, the forest cover has been updated for disturbances to December 2000, except for the 82F/82J mapsheets that have been updated to December 2001. Logged block information compiled by licensees was used to further update disturbances to Jan 2003 in the TSR3 resultant file.

- The forest cover attributes have been projected to January 1, 2003.

- An audit of the inventory was completed in 1996 and showed that natural stands contained 3.4% more volume than was predicted by the inventory, though the difference was not deemed statistically significant.

- The volumes associated with partially harvested stands within the inventory (history record shows a % logging history) have been adjusted to account for over-prediction of volumes by VDYP. VDYP does not accurately reflect volume removal in partially harvested stands, so a manual adjustment to the volumes, to reduce them by the area disturbed, has been performed on these stands. (Refer to section 4.5 for more detail.)

- The current inventory exists in tables that have been 'Rolled Over' into INCODSADA from an FC1/FIP inventory. (No new data – simply FIP data in new MS Access tables)

1.3 Thematic Data Sources

Table 1. Summary of thematic data sources.

Issue or Data	Description, Source	Coverage Name	Version or Date Stamp
Administrative Linework			
Landscape Units	Landscape Unit Boundaries, MSRM Nelson	DIN_LU	2002
Planning Cells	Important watersheds for management constraints, MSRM Nelson	PCELL	2000
Operability	Operability Line finalized in 2003 by Licensees & Forest District staff	DIN_OP	2003
Ownership	Ownership, MSRM Nelson updated by Forsite	OWNER	2003
Inventories			
BEC Variants	Biogeoclimatic Variants, MSRM Nelson	DIN_BEC_SEP03	2002
NDT Types	Natural Disturbance Types calculated based on BEC, Forsite	DIN_BEC_SEP03	2003
Slope Classes	0 – 40%, 41 – 70%, 71 – 80%, and >80% slope classes, MSRM Nelson	DIN_SLP_BR	2002
Forest Cover	Forest Cover for Forest District, Victoria Data Warehouse	DIN_FC_NOV03	Aug 2003
Park Forest Cover	Forest Cover for Purcell Wilderness (82F097-099), MSRM Nelson	(Inv Branch dgn files)	1997
Terrain Classification	Terrain Classification, TEMBEC, Galloway, BCTS	DIN_TERRAIN	Sep-03
ESA's	Environmentally Sensitive Areas, previous version of Forest Cover	DIN_FC_NOV03	1992
Management Guidelines			
Connectivity Corridor	KBHLPO - MSRM Nelson	CONCOR	1999
Community Watersheds	All Community and District Watersheds - MSRM Nelson	DIN_CWS_DWS	2003
Ungulate Winter Range	KBLUP UWR using Snow Depth, MSRM Nelson	UWR_KBLUP_DIS /	1997
	New UWR based on PEM, MSRM Nelson with refinements by Forsite	UWR_PEM_DIS	2003
Fire Maintained Ecosystem Restoration	Ecosystem Restoration Mapping, MSRM Nelson	FMER	1998
Caribou	KBLUP Blue Blobs using Priority 1 and 2 areas, MSRM	DIN_CARI_KBL	1997
	New Caribou, MSRM Nelson with refinements by Forsite	DIN_CARI_NEW3	2003
Visual Quality Objectives	VQO polygons provided by Rex Durell (MoF District)	VQO_DIN	2003
Lake Management Zones	All L1 lakes not NDT 4 buffered 200m, Forsite	DIN_LMZ	2003
Riparian Network	Rivers, wetlands buffered according to classification see details in data package, Forsite	DIN_BUFFER	2003
Enhanced Resource Development Zones	KBHLPO ERDZ's – THLB does not match but MSRM directed its use anyways - MSRM Nelson	DIN_ERDZ	2003
Transportation Network	Roads, Pipelines, Railways buffered see details in data package, Forsite	DIN_BUFFER	2003
Potential OGMA Ranking	MoF ranked OGMA candidates	DIN_OGMA	2002
Other / Special			
Forest Fires	2003 Forest Fires, MSRM	DIN_FIRES03	Sep-03

2.0 Land Base

2.1 Timber harvesting land base definition

The crown forested land base (CFLB) is the area of productive forest under crown ownership. This is the total area of land base that contributes to landscape level objectives for biodiversity and resource management. The crown forested land base excludes non-crown land, woodlots, non-forest and non-productive areas. For the purpose of this analysis, it included Kootenay National Park (Section 2.3.1).

The timber harvesting land base (THLB) is the portion of the management unit where forest licensees under license to the province of BC are expected to harvest timber. The THLB excludes areas that are inoperable or uneconomic for timber harvesting, or are otherwise off-limits to timber harvesting. The THLB is a subset of the crown forested land base. Table 1 summarizes the land base for the Invermere TSA.

Table 1. Timber harvesting land base area netdown summary

Factor	Total area (ha)	Effective* Area (ha)	% of Forest District	% of Crown forest
Total area (Invermere Forest District less TFL14)	1,153,073	1,153,073	100%	
Less:				
Private Land, First Nation reserves	74,034	74,034	6.4%	
Woodlots, X-mas tree permits, Misc Leases	16,264	16,264	1.4%	
Total TSA Area	1,062,775	1,062,775		
Non-forest / Non-productive forest	520,970	496,284	43.0%	
Non-Commercial Brush	146	146	0.0%	
Backlog NSR (non-productive stands)	971	936	0.1%	
Unclassified existing roads, trails and landings	17,573	10,759	0.9%	
Total Crown Forested Land Base (CFLB)**		554,650	48.1%	100%
Less:	In CFLB:			
Fed Parks, Prov Parks and Reserves	232,340	77,666	6.7%	14.0%
Inoperable/Inaccessible	254,162	183,861	15.9%	33.1%
Operable/Inaccessible (Slope > 70%)	4,320	4,296	0.4%	0.8%
Unstable Terrain	32,307	6,893	0.6%	1.2%
Environmentally Sensitive Areas (excludes Es except where terrain mapping does not exist)	82,151	6,723	0.6%	1.2%
Non-Merchantable	24,810	5,335	0.5%	1.0%
Low Sites	100,611	11,643	1.0%	2.1%
Problem Forest Types	9,828	6,024	0.5%	1.1%
Riparian Management Areas	31,415	17,669	1.5%	3.2%
Existing Wildlife Tree Patches	844	637	0.1%	0.1%
Timber Harvesting Land Base –THLB (ha)		233,873	20.3%	42.2%
Volume Reductions:				
Identified Wildlife Management Strategy	0%	0		
Future Wildlife Tree Patches (%)	1.6%	3,812		
Other Future Reductions:				
FMER Open Range		1,585		
Future roads, trails and landings		11,016		
Long-term Timber Harvesting Land Base (ha)		217,531		

* Effective netdown area represents the area that was actually removed as a result of a given factor. Removals were applied in the order shown above, thus areas removed lower on the list do not contain areas that overlap with factors that occur higher on the list. For example, the unstable terrain netdown did not include an non-forested or inoperable area.

** Crown forest in this context denotes the forest area that contributes to forest management objectives, such as landscape-level biodiversity, wildlife habitat and visual quality. It did not include alpine forest or Non Productive areas with trees species.

2.2 Changes from TSR2 affected the THLB

Since the last timber supply review for the Invermere TSA, several input datasets changed, and resulted in some adjustments to the size of the timber harvesting land base for the unit. In summary, these changes were:

- Operable area for the TSA was reviewed in 2003 to confirm the merchantability and economic viability of accessing forest stands in the TSA. A new operable area was identified after areas were both removed (10.1%) and added (7.4%) to the old operability line. This resulted in a gross operable area that is 2.7% less than the old operability line. The net impact on THLB was dependant on how additions and subtractions were dealt with in the netdown process. Details in Section in 2.4.1
- The area known as the 'Findlay Corridor', an access corridor through the Purcell Wilderness Conservancy, was confirmed to be off limits for land uses other than mining[1]. Removing this access corridor subsequently isolated the headwaters of the Middle Findlay, resulting in a total decrease in the operable area of 2,975ha (not reflected in the bullet above). Details in Section 2.3.1
- Where terrain stability mapping (Level B or Level D mapping) was completed in the TSA, it was used in place of the older Environmentally Sensitive Area (ESA) soils mapping. ESA soils mapping was used in only in a small portion of the TSA (6% of the operable CFLB). Details in Section 2.4.2
- Backlog NSR (Not Satisfactorily Restocked) areas were reviewed by district staff and significant proportions were reclassified. This resulted in areas being removed from the land base, areas being reclassified as restocked, and areas being confirmed as actual NSR. This analysis removed 936 ha from the THLB because these areas were not likely to produce a commercial crop of trees in the future.
- The THLB area in this analysis spatially excluded existing WTPs and existing trails/landings. TSR2 addressed these issues through yield curve reductions and thus they did not factor into the calculation of the THLB area.
- The netdown for existing trails and landings in this analysis was larger than TSR2 because the percentage area reduction was applied to a larger area at the start of the analysis. Any stand with a logging history (~102,500 ha) received the 6.5% area reduction as part of the existing road buffering exercise, whereas in TSR2, a 6.5% volume reduction was applied only to stands considered 'managed' (<31 yrs. old). In TSR2, this meant less area was removed at time zero, and the area removed did not influence the TSR2 THLB number (as described in the bullet above).

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[1] Personal Communication: Tom Volkers – MSRM, Cranbrook, BC, November, 2003

2.3 Exclusions from the Crown Forested Land Base

2.3.1 Ownership classes not part of the TSA

The area of the Rocky Mountain Forest District is divided into ownership codes that describe the nature of ownership of a particular parcel of land. For forest management in the Invermere TSA, only those lands that are under provincial crown ownership will contribute to forest management objectives, like landscape level biodiversity. For the purpose of this analysis, Kootenay National Park was included in the crown forested land base[2]. Ownership classes coded for timber management (coded as '-C') contributed toward timber harvesting activities. Parcels of land coded as non-contributing ('-N') were treated as land base removals. Table 2 below describes the various ownership codes in the Invermere TSA, and their contribution to the Crown Forested Land Base, the Timber Harvesting Land base, or both.

Table 2. Ownership codes and application in TSR3

Ownership Code (own)	Description	Percent Contribution to Crown Forested Land base	Percent Contribution to Timber Harvesting Land base	Total area (hectares)
51-N	National Parks (Kootenay)	100%	0%	41,455
60-N	Ecological Reserves	100%	0%	153
61-C	U.R.E.P Reserves – contributing	100%	100%	10,309
61-N	U.R.E.P Reserves – non-contributing	100%	0%	1,026
62-C	Forest Management Unit	100%	100%	531,760
63-N	Provincial Park Class A	100%	0%	186,226
69-C	Misc. Reserves – contributing	100%	100%	288,365
69-N	Misc. Reserves – non-contributing	100%	0%	3,481
70-N	Timber Licenses	0%	0%	0
75N	X-mas Tree Permits	0%	0%	7,740
77N	Woodlot Licenses	0%	0%	7,617
99N	Misc Leases	0%	0%	827
All Others	Private Land, First Nation Reserves.	0%	0%	74,114
Total Area				1,153,073

The current ownership layer was provided by the Ministry of Sustainable Resource Management in Nelson, BC. The ownership was considered current to 2002. The status of woodlots in the TSA has not changed since TSR2. Edits were made to the ownership file for TSR3 as follows:

- The area known as the 'Findlay Corridor', an access corridor through the Purcell Wilderness Conservancy, was confirmed to be off limits for purposes other than mining. Removing this access corridor subsequently isolated the headwaters of the Middle Findlay, resulting in a total decrease in the operable area of 2,975ha.
- Established ski resorts were confirmed to be excluded from the timber harvesting land base. Expansion areas were specifically excluded from the THLB.
- Areas of 61-N and 69-N (see definitions in above table) that were greater than 100ha, were changed to 61-C and 69-C respectively. Similarly, areas of 61-C and 69-C that were less than 100ha, were changed to 61-N and 69-N. The areas less than 100ha were removed from the land base. This reflected the reduced timber harvesting opportunity in and around the smaller recreation features in the Invermere TSA. Other consideration for recreation within the TSA was covered by visual quality management and forest cover requirements for recreation in high value recreation corridors.

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[2] As directed by Ken Gorsline, MSRM Kootenay Regional Director, Pers comm, Nov 28, 2003.

2.3.2 Non-forest and non-productive forest

The forest cover inventory that was used in this analysis originated in 1995 and was updated in 1998 and 2001. The inventory has since been 'rolled-over' into the newer VEG format of forest cover inventory (in 2002), but still retained the basic attributes of the original inventory, like non-productive descriptor. The non-productive descriptor (see the table below) was used to reduce the land base of the TSA for areas that are not capable of growing productive forest stands.

Table 3. Non-forest area

Code (NPD_CD =)	Description (NPD_DESCRP =)	Percent Reduction	Total area (hectares)	Area Excluded (ha)
01	Icefield	100%	1,791	1,791
02	Alpine	100%	307,266	307,170
03	Rock	100%	13,081	12,857
06	Gravel	100%	2	2
09	Clay	100%	1,768	844
10	Alpine Forest	100%	79,607	79,576
11	Non-Productive Brush	100%	8,784	8,221
12	Non-Productive	100%	41,453	39,957
13	Non-Productive Burn	100%	9,536	9,268
15	Lake	100%	9,519	8,828
18	Gravel Bar	100%	387	352
25	River	100%	5,331	4,835
35	Swamp	100%	10,948	6,721
42	Clearing	100%	7,894	983
54	Urban	100%	5,729	1,447
62	Meadow	100%	311	240
63	Open Range	100%	9,760	5,490
0	No Typing Available*	100%	7,803	7,702
Total			**520,970**	**496,284**

* The area of NTA corresponds to the area of KNP without any forest cover typing (Original LU = KNP2).

2.3.3 Non-commercial cover

Non-commercial cover is productive forest land that is otherwise occupied by non-commercial tree or shrub species. This area of land does not currently grow commercial tree species, and is not expected to do so without intervention. This area was therefore excluded from the crown forested land base.

Table 4. Non-commercial cover

Description	Percent Reduction	Total Area (ha)	Area Excluded (ha)
Non-Commercial Brush (NF Desc=NCBr)	100%	146	146

2.3.4 Backlog NSR - unproductive sites

Backlog NSR (Not Satisfactorily Restocked) areas identified in TSR2 were reviewed by district staff[3] and significant proportions were reclassified. This resulted in areas being either removed from the land base, areas being classified as restocked, and areas being confirmed as actual NSR. The portion of the Backlog NSR that was designated to be removed from the land base resulted from unacceptable economics associated with bringing these sites back into production.

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[3] Lynn Konowalyk, MoF. Pers Comm, Oct 2003

Table 5. Backlog NSR - unproductive sites

Description	Percent Reduction	Area Excluded (ha)
NSR-Unproductive	100%	971 gross, 936 net

2.3.5 Roads, trails, and landings

Quantifying the area that is, and will be, disturbed by roads, trails, landings (RTLs) and other access features in the TSA was an important part of determining the THLB. Area that was expected to remain non-productive was removed from the working land base as outlined below.

2.3.5.1 Classified roads

Classified roads are those roads identified in the forest cover inventory. These roads are frequently large roads or highways with a wide right-of-way. This area was removed from the THLB based on coding in the forest cover file. See Table 3 for a review of the codes netted out of the forested land base – roads were typically classified as 'Urban' or 'Non-Productive'.

2.3.5.2 Unclassified roads, trails, and landings

Right-of-way widths were determined through discussions with knowledgeable Licensee and Ministry staff[4] and by reviewing values used in previous east Kootenay TSRs. Because of the similarities in the two units, an attempt was made to be consistent between Invermere and Cranbrook TSAs. Road widths in Table 6 represent an average unproductive width for each of the road types shown. Widths for railways and power lines were taken from the Cranbrook TSR2 analysis.

A complete roads layer for the TSA was developed in 2003 by adding recently constructed roads to an existing district roads coverage. Each road was assigned a type and then buffered to the widths shown below. The buffered areas were considered unproductive and were netted out of the crown forested land base. The difference between the total area and excluded area in Table 6 is because some of this area was already removed because of ownership or non productive status in the forest cover file.

Table 6. Access feature classification

Access feature/ class	Road length (km's)	Road width (metres)	Percent Reduction	Total Area (hectares)	Area Excluded (ha)
Highway	318	40.0	100%	9,225	6,330
Secondary Road	1,039	15.9	100%		
Logging Road	6,207	8.5	100%		
Trail	2,325	3.0	100%		
Railway	218	33.8	100%	616	81
Power Line	216	49.0	100%	734	66
			Totals	**10,575**	**6,477**

Note: Overlap between these features and non-forested areas in Table 3 exist but no double counting occurs during netdowns.

* This gross area is less than the area obtained by multiplying road lengths and widths. This was because the GIS coverage did not double count overlaps between feature types or the buffer overlaps that occurs at all intersections.

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[4] Mike Black / Gary Dolynchuk / Greg Anderson, Ministry of Forests, Cranbrook, BC, Pers. Comm. September 16, 2003

Table 7. Unclassified roads, trails, and landings

Feature Type	Reduction percent (%) applied to existing harvested areas	Total area (ha)	Area Excluded
Access Features	Refer to area in Table 6	10,575	6,477
In block Trails	4.5% (SBFEP soil disturbance surveys in 1994/95 + professional judgement)	4,841	2,965
In block Landings	2.0% (1/4 ha landing per 8 ha harvested – reduced by 1% for overlap with roads)	2,151	1,317
Totals	Existing access features plus existing trails and landings	**17,567**	**10,759**

Based on estimates provided by the Regional Pedologist for TSR2, reductions to account for in-block trails and landings are defined as shown in Table 7. These estimates take into account varying practices throughout different time-periods in the TSA, and how these practices have improved over time, to reduce the unproductive area created by landings and logging trails. The values remain unchanged from TSR2. These percentages were translated into equivalent areas (i.e., 4.5% of logged area –107,578 = 4,841 ha) and then applied spatially through enlarged buffers on existing logging and secondary roads. The total netdown for existing roads, trails, and landings can be found in Table 7 above.

2.4 Exclusions from the Timber Harvesting Land base

2.4.1 Inoperable/inaccessible

Inoperable areas are areas that are not available for timber harvesting because of adverse terrain characteristics such as steep slopes, unfeasible road access or uneconomic yarding or flight distance. In the Invermere TSA, operability was reviewed in 2003 by forest licensees and the BC Ministry of Forests. The new operability line more accurately excludes stands that are uneconomic to access or are physically impossible to access with current technology. As a result, the operable land base decreased in size by 12,010 hectares since the last timber supply review. In addition, any slopes > 70% inside the operable area were excluded from the timber harvesting land base. Slopes > 70% are typically not utilized in this TSA and were therefore not considered harvestable with current technology.

Table 8. Inoperable land base

Criteria	Percent Reduction	Crown forested land base (hectares)	Area excluded (hectares)
Physically and economically inaccessible with current technology (oper = I, N, or X)	100%	254,162	183,861
Slopes > 70% (below operability line)	100%	4,320	4,296
Total		258,482	188,157

2.4.2 Environmentally sensitive areas

Environmentally sensitive sites and areas of significant value for other resource uses have been delineated within the forest cover inventory as Environmentally Sensitive Areas (ESA's). ESA's are a broad classification of areas that indicate sensitivity for unstable soils (E1s), forest regeneration problems (E1p), snow avalanche risk (E1a), and high water values (E1h). Since the last TSR in the Invermere TSA, ESA soils mapping has generally been replaced with level B and level D Terrain Stability mapping completed over much of the operable land base. Terrain stability mapping provides a better estimate of unstable soils than the E1s mapping, but where no mapping was completed, ESA1 soils polygons were used to indicate unstable slopes. The use of Terrain Stability mapping is described in the next section.

Table 9. Area reductions for Environmentally Sensitive Areas

ESA category	ESA description	Percent reduction	Total Area (ha)	Area excluded (hectares)
E1a	Severe snow avalanching	**100%**	39	17
E1h	High water values	**100%**	3,988	2,525
E1p (outside of FMER OR and OF)	Severe regeneration problems caused by biotic factors	**100%**	51,731	3,952
E1s (where no terrain mapping exists – 25% of CFLB, 6% of operable CFLB)	Sensitive / unstable soils	**100%**	26,393	229
		Total	82,151	6,723

2.4.3 Unstable Terrain

Tembec, Canfor, and BC Timber Sales have completed terrain stability mapping for most areas of concern in the TSA. Mapping was completed in a variety of projects to various intensities of mapping (Level B and D), largely to satisfy operational and regulatory requirements. Spatial coverages of terrain mapping from numerous licensee projects were appended together into a single layer. The stability attribute from all the separate inventories were compiled into a 'Final_Class' attribute, where the stability class from the most intensive mapping, was given precedence over the least intensive mapping when overlaps occurred. As these data were considered more accurate than ESA mapping, it eliminated the need for ESA soils mapping (described above) for determining unstable terrain where it exists. The netdowns below represent the best knowledge about the extent of unstable terrain in the TSA and were meant to capture those areas where logging is completely excluded. There is an acknowledgement that the classes assigned in the terrain mapping are further refined in the field during cutting permit development. For example, a portion of the polygons mapped as "unstable" or "partially unstable" are typically confirmed to be acceptable for timber harvesting in the field. These mapped classes serve as a red flag for field operations and do not automatically exclude these areas from harvest. Based on field experience in the Invermere TSA, Table 10 shows the approximate proportion of each class that will be removed from the land base.

Table 10. Field based interpretations to be applied to terrain mapped polygons

Mapped Terrain Class	Confirmed Unacceptable for harvest in the field	Confirmed Acceptable for harvest in the field
U (unstable)	90%	10%
P (potentially unstable)	5%	95%

Notes: Based Canfor and Tembec field staff experience with Level D Terrain Mapping in the Invermere TSA.

For purposes of modeling, netdowns were performed as per Table 11 – all polygons labeled as V or U were removed. This subset of the terrain polygons resulted in a netdown of area consistent with field operations. Where no terrain mapping existed, the ESA soils designation was used as described in Table 9 above.

Table 11. Area reductions for unstable terrain

Mapped Terrain Class	Percent Reduction	Crown forested land base (hectares)	Area excluded (hectares)
V (high mass wasting hazard) from Level B mapping	100%	0	0
U (unstable terrain) from Level D mapping	100%	32,307	6,893
Total		**32,307**	**6,893**

2.4.4 Non-merchantable forest types

Non-merchantable forest types are stands that contain tree species not currently utilized, or timber of low quality, small size and/or low volume. Non-merchantable types are entirely excluded from the timber harvesting land base. In the Invermere TSA, deciduous-leading (hardwood) stands are not considered economically viable. Similarly, whitebark pine-leading stands are not pursued by licensees, as these stands tend to have poor wood quality. These stands were excluded entirely from the timber harvesting land base.

Decadent timber types (Cw/Hw/Bl leadings stands over 200 years old) were also removed from the land base because of economic uncertainty. A portion of these stands may be harvestable during good pulp markets but they have been removed because, on balance, there are likely small areas under 200 years old that may prove to be decadent as well.

Stands within parkland BEC variants[5] were specifically excluded from the land base because the BEC variant mapping was coarse relative to the detailed stand level mapping available in forest cover data. Forest stand attributes were used to remove those stands not suitable for harvesting. Forest cover data were used to develop a merchantability model that was one of the inputs used in developing the new operability line. Thus, most non-merchantable stands in at higher elevations were already excluded as inoperable/non merchantable. The remainder were caught using stand specific attributes (low site index, marginal species) or other netdowns (slope>70%, unstable, ESAs, etc). There were 1383 ha (2.6%) of the 'upper' variants included in the THLB. Appendix E provides a breakdown of area by BEC variant in the CFLB and THLB.

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[5] The new (2003) BEC variant line work broke the old ESSF variants into regular and 'upper' variants. For example, the old ESSFdk broke into the ESSFdk1, ESSFdk2, and ESSF dku.

Table 12. Non-merchantable forest types

Species	Inventory type group	Percent Reduction	Crown forested land base (hectares)	Area excluded (hectares)
Deciduous leading	35-42	100 %	6,666	4,293
Pa leading	28 (where Pa leading)	100 %	615	31
Cw/Hw leading	9-17 over 200 yrs old	100%	931	226
Bl leading	18-20 over 200 yrs old	100%	10,805	783
Total			**19,017**	**5,333**

2.4.5 Low productivity sites

Low productivity sites are areas that are not suitable for timber harvesting due to low timber growing potential. These stands have suitable species for timber harvesting but are not expected to contribute to the THLB because they take too long to grow a commercial crop of trees.

In the Invermere TSA, timber harvesting utilizes different harvesting systems depending on slope gradient. On slopes >= 40%, cable harvesting or more expensive ground based systems are typically used. On slopes < 40%, conventional harvesting methods are used. In general, steeper slopes require a higher threshold of timber volume and piece size to be considered economic and this was reflected in a higher minimum site index threshold. The low site definitions used here are more detailed than those used in TSR2 and are consistent with the Cranbrook TSA (both TSR2 and TSR3).

Table 13. Low site netdowns

Leading species	Inventory Type Group Number	Site index	Slope (%)	Percent Reduction	Total Crown forested land base (ha)	Area excluded (ha)
Pl Leading	28-31	< 10.0	< 40	100 %	4,167	934
Pl Leading	28-31	< 12.0	>= 40	100 %	28,925	2,751
F leading except FS	1-3, 5-8	< 10.0	< 40	100 %	759	656
F leading except FS	1-3, 5-8	< 13.0	>= 40	100 %	16,003	3,106
FS, S, Pw	4, 21-26, 27	< 8	All	100%	33,645	2,454
All others	9-20,32-34	<10	All	100%	17,112	1,742
Total					**100,611**	**11,643**

2.4.6 Problem forest types

Problem forest types are stands that currently occupy sites that have the potential to produce merchantable timber but are currently not utilized due to marginal merchantability. To reflect recent and current management practices, the area of problem forest types identified in Table 14 was removed from the timber harvesting land base. Based on the Chief Foresters direction in TSR2, the detailed approach used in TSR1 was re-evaluated[6] against current management practices and found to be broadly acceptable. A few changes were made to the TSR1 PFT definitions:

- All Fd/Lw/Py definitions remain unchanged but the % exclusions were altered slightly.
- The Pl leading 320 and 420 types were limited to below site index (SI) 16 and their % exclusion was increased significantly.
- A consistent treatment was applied to mature Pl leading stands (age class 5-9)

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[6] Completed by Barry Benson (Tembec), Rory Hromadnik (Canfor) and Al Neal (consultant/ex-Invermere MoF Planner)

Table 14. Problem forest type definitions

PFT No.	Species	Inventory Type Group	Age	Ht Class*	Stk Class**	Site Index	Operable Crown forested landbase (ha)	% Excluded	Gross Area Excluded (ha)	Net Area Excluded (ha)
1	Fir, L, Py	1-8,32-34	81-100	2	0	<16	6,076	20	1,215	915.0
2	Fir, L, Py	1-8,32-34	101-120	2	0	<16	4,003	30	1,201	640.6
3	Fir, L, Py	1-8,32-34	>120	2	2	<16	148	100	148	16.3
4	Fir, L, Py	1-8,32-34	61-80	1	0	<16	377	20	75	0.0
5	Fir, L, Py	1-8,32-34	61-80	2	0	<16	4,662	10	466	265.9
6	Fir, L, Py	1-8,32-34	41-60	1	0	any	1,177	10	118	0.0
7	Fir, L, Py	1-8,32-34	41-60	2	0	any	2,529	10	253	250.6
8	Pl Leading	28-31	41-60	1	0	<16	347	50	174	90.0
9	Pl Leading	28-31	41-60	2	0	<16	594	80	475	435.7
10	Pl Leading	28-31	61-80	1	0	<16	116	100	116	25.5
11	Pl Leading	28-31	61-80	2	0	<16	5,117	70	3,582	2906.1
12	Pl Leading	28-31	>80	2	1	any	5,573	10	557	105.2
13	Pl Leading	28-31	>80	2	3	any	5,096	20	1,019	335.7
14	Pl Leading	28-31	>80	2	4	any	610	70	427	37.6
Total							**36,427**		**9,828**	**6024.2**

* Height class 1 is <10.5m, height class 2 is >= 10.5m and < 19.5m

** Stocking class 0 is immature, 1 is >= 76sph over 27.5cm dbh, 2 is <76sph over 27.5 cm dbh, 3&4 describe small diameter, dense pine stands.

2.4.7 Existing Wildlife Tree Patches

Existing wildlife tree patches have been excluded from current timber harvesting activities, and are expected to remain on the landscape for at least one rotation. An equivalent area of mature forest will always exist in WTP's so this area was removed from the timber harvesting land base. A layer of existing wildlife tree patches was compiled from forest development plans from the TSA licensees (No data was available from Canfor). Further information on how wildlife tree patches were addressed in the analysis can be seen in Section 7.5.2.

Table 15. Existing Wildlife Tree Patches

	Percent Reduction	Area Excluded (ha)
Existing Wildlife Tree Patches	100%	637

2.4.8 Riparian reserves and management zones — streams

In preparation for TSR2, riparian habitat was mapped by a biologist onto orthophotos (1998). This data was the backbone of the riparian netdowns in TSR2.

As the TSR2 orthophoto exercise primarily addressed reserve zones on S1-S3 streams and large wetlands, many riparian features in the TSA were not addressed. A digital TRIM stream network was developed by Forsite from numerous sources (MoF, Tembec, Canfor), to create a comprehensive representation of streams in the TSA. Numerous streams had field based classifications from Tembec/Canfor/BCTS, but most were simply classified by gradient, as either fish or non-fish. Building on the existing TSR2 dataset, each additional TRIM stream was buffered with an "effective" reserve zone that represented the areas of any reserve plus an area equivalent to the retention requirement in the riparian management zone (See section 2.4.8.2 below for details). The combined riparian area of the TSR2 and TSR3 exercises was excluded from the timber harvesting land base in TSR3.

2.4.8.1 Riparian reserves

Riparian reserves around streams in the Invermere TSA are excluded from the timber harvesting land base. Reserve zone widths for the various stream classifications are shown in Table 16. These areas were excluded from timber harvesting activities.

2.4.8.2 Riparian management zones

Management practices within riparian management zones also result in areas excluded from the timber harvesting land base. As per the best management practices recommended in the *Riparian Management Area Guidebook*, a portion of the volume/area of these zones was retained (Table 16). In the analysis, this was represented by an additional buffer width that was 100% excluded. When the reserve zone and representative portion of the management zone were added together, an "Effective" buffer width was defined and then ultimately used in the model. See Table 16 for a description of the riparian management netdown assumptions.

Table 16. Riparian reserve and management zones — streams

Riparian class*	**Stream length (km)**	**Reserve width (m)**	**Management zone width**	**Management zone retention (%)**	**Effective Buffer Width (m)** (both sides)**	**Percent Reduction**	**Percent Contribution to Biodiversity**
S1	294	50	20	50%	60	100%	100%
S2	285	30	20	50%	40	100%	100%
S3	356	20	20	50%	30	100%	100%
S4	445	0	30	25%	8	100%	100%
FISH^	9,221				28.3	100%	100%
S5	247	0	30	25%	8	100%	100%
S6	2,932	0	20	5%	1	100%	100%
Non-Fish^	15,248				1.5	100%	100%
TOTAL	**29,028**						

* Stream classes are defined in the Riparian Management Guidebook. S1-S4 are fish bearing, while S5-S6 are non fish bearing.

** Effective width was calculated as Reserve Width (m) + (Management Zone Width x Management Zone Retention)

^ "Fish" buffer widths were based on a weighted average of 13%-S1, 22%-S2, 29%-S3, and 36%-S4. "Non-Fish" values were based on a weighted average of 8%-S5 and 92%-S6. These values were obtained from watersheds with known fish stream data in the Invermere data set.

2.4.8.3 Riparian reserve and management zones — wetlands and lakes

Lakes and wetlands in the Invermere TSA were extracted from forest cover and TRIM data, and classified in accordance with the *Riparian Management Area Guidebook* and the *Regional Lake Classification and Lakeshore Management Guidebook*. Similar to the riparian reserves around streams, a buffer coverage around each lake / wetland was created to represent the area deducted from the timber harvesting land base. See Table 17 below for the effective buffer width around each class of lake or wetland.

Large lakes (L1 lakes) will typically only have a narrow 10m reserve, or no reserve around them. A 200m lakeshore management zone was implemented around these large lakes and was modeled using a forest cover requirement (see section 7.7) consistent with visual and recreation values. The exception to this were the large lakes in the NDT 4 natural disturbance type, where standard forest practices are applied. These lakes are often in open forest or open range conditions and forest cover requirements do not apply.

Table 17. Riparian reserve and management zones — wetlands and lakes

Riparian class*	Reserve width (m)	Management zone width (m)	Management Zone Retention (%)	Effective Buffer Width (m)**	Reduction percent
L1 Lakes > 1000 ha	0	200	15%	0 m	0 %
L1 Lakes <= 1000 ha	10	190	15%	10 m	100 %
L2 lakes	10	20	50	15 m	100%
L3 lakes	0	30	50	15m	100%
L4 lakes	0	30	50	15m	100%
W1 wetlands	10	40	50	30m	100%
W2 wetlands	10	20	50	20m	100%
W3 wetlands	0	30	50	15m	100%
W4wetlands	0	30	50	15m	100%
W5 Wetlands	10	40	50	30m	100%

* Refer to the "Forest Practices Code of British Columbia Riparian Management Area Guidebook, Tables 1, 2, 3" for classification guidelines. Lakes and wetlands were extracted from the forest cover inventory, and TRIM, where it exists.

** Effective width was calculated as Reserve Width (m) + (Management Zone Width x Management Zone Retention). In the case of L1 lakes, the management zone was not part of the buffer because it was addressed through using forest cover requirements (section 7.7).

2.4.9 Wildlife habitat deductions – Identified Wildlife

The provincial *Identified Wildlife Management Strategy* provides for the creation of wildlife habitat areas (WHA) within the TSA, to protect key habitat features of listed wildlife species. No spatial land base deduction was implemented for Identified Wildlife because existing WHA's do not have timber supply impacts and proposed WHA's were not yet official at the time of the analysis.

The only existing WHA is for Lewis' woodpecker near Findlay Creek. A WHA for Bull trout on Skookumchuck Creek has been in draft stage for a long time, while other proposed WHA's are in progress for long-billed curlews and flammulated owls.

Provincial policy states that WHA's can have a short term AAC impact of up to 1%. At the time of this analysis, very few WHA's have been designated in the TSA, however it was recognized that an impact of up to 1% may be considered to account for the eventual deployment and establishment of WHA's.

In this analysis, no reductions were incorporated to address the potential 1% impact for IWMS. The likely impact of IWMS can be discussed by the Chief Forester in his AAC rationale. Refer to Section 7.4.2 for more information.

Table 18. Reductions for Identified Wildlife

Wildlife species	Percent reduction
Identified Wildlife Management Strategy	0%

2.4.10 Cultural heritage resource deductions

A cultural heritage resource is defined in the Forest Act as, "an object, site, or location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community, or an aboriginal people". Cultural heritage resources include archaeological sites, structural features, heritage landscape features and traditional use sites. Archaeological overview assessments and Traditional Use Surveys have been completed for the Invermere TSA. Archaeological Impact Assessments are conducted where required to help ensure the protection of cultural heritage resources. Many known archaeological sites occur in riparian areas that are already deducted from the timber harvesting land base, and where this does not occur, sensitive sites are currently protected using management practices such as wildlife tree retention, machine-free zones, or winter logging. It was expected that, with respect to the timber supply analysis, most archaeological and cultural heritage concerns can be addressed by management practices and land base deductions for other factors. Existing netdowns and management practices provide a range of habitats, seral stages, plants and animals that help support traditional uses of the land base. Additional land base deductions specific to cultural heritage resources were not applied in this timber supply review.

It is important to note that the Ktunaxa Nation, which includes Kinbasket peoples, asserts traditional title and rights within their traditional territory which includes the Cranbrook TSA. The Ktunaxa are currently in stage 4 of the 6-stage Treaty Negotiation Process. This timber supply review does not limit, and was not intended to limit ongoing Treaty negotiations between the Ktunaxa Kinbasket Treaty Council, British Columbia and Canada.

2.4.11 Future roads, trails, and landings

Deductions for future roads are necessary to account for the unproductive area created as new roads, trails and landings are created. A first logging entry into any unroaded areas in the TSA will capture all of the timber volume available in that stand. Any subsequent entries will harvest less volume, recognizing the unproductive area that would then exist as roads, trails and landings.

Table 19 shows the estimates of unproductive area due to roads, trails, and landings in the future. These estimates were a reflection of the improved practices in the TSA, and were assumed to remain constant into the future. The estimate for future roads recognized that much of the road infrastructure already exists in the TSA, and thus lowered the net loss associated with accessing future harvesting areas.

Deductions for future roads, trails and landings were applied as a volume reduction to the yield tables of all Future Managed Stands.

Table 19. Future roads, trails, and landings

Feature Type	Reduction percent (%) (applied once to any future harvested areas)
Roads	0.6% (Soil disturbance surveys from east Kootenays 1994 – consistent with TSR2)
Trail	4.5% (based on SBFEP soil disturbance studies in 1994/95).
Landings	3.0% (1/4 ha landing for every 8 ha harvested – consistent with TSR2).
Total	**8.1%** (applied as a volume reduction to all Future Managed Stand yield tables)

The intention of this analysis was to apply the deductions for future roads, trails and landings as a volume reduction to all yield tables for Future Managed Stands. However, this reduction was only applicable to stands that have not already had a reduction associated with existing roads, trails, and landings. Because a portion of the existing natural stands did experience this netdown already (logged previously but not considered managed stands), the percentage should not be applied again once these sites become managed stands. Thus, the portion of the future managed stands that would already have experienced the reduction was prorated against the portion that still required the 8.1% reduction – resulting in a 5.8% reduction applied to all future managed stands.

The application of this volume reduction was approximately equivalent to the removal of 11,016 ha of THLB in the future (5.8% of the existing natural stand area – 189,926 x 5.8% = 11,016 ha). When this area was added to the netdown for existing roads, trails, and landings (10,759 ha), a total land base impact of 21,775 ha associated with roads, trails, and landings was realized in the long term. This represented 9.1% of the THLB area.

3.0 Management zones and analysis units

3.1 Management zones and objectives

In order to accommodate the range of timber and non-timber resource objectives that occur within the TSA, forest cover requirements were applied within the timber supply model. These requirements maintain appropriate levels of specific forest types that are needed to satisfy objectives for wildlife habitat, visual quality, biological diversity, etc. Table 20 describes the types of management zones that occur in the TSA, while the specific forest cover requirements to be applied are discussed under Section 7.0, "Integrated Resource Management".

Table 20. Management Zone Definitions

Name	Crown Forested Area (ha)	THLB Area (ha)	Criteria used to delineate zone/group	Rationale/comments
High Biodiversity Emphasis Areas	119,427	25,416	Old Seral Goals: LU 1, 2, 11, 16, 17, 22, 23	Designated by the HLPO (Oct 2002). Requirements exist to maintain old and mature forest for biodiversity. When retained old and/or mature stands for biodiversity – connectivity corridors and grizzly habitat areas were given a high priority. This analysis used the 2003 BEC variant mapping. The HLPO BEO map was based on the previous BEC mapping. For this analysis, the BEO's were remapped so that each new LU/BEC variant belonged to only one BEO and was consistent with the text descriptions of the original BEO's. ESSFwm in LU10 no longer exists so ESSFdk2 was assigned an intermediate BEO.
	44,934	12,599	Mature Seral Goals: LU 1 (ESSF dk1 only) LU 2, 11, 17 (ESSF dk1 / MS dk only) LU 16 (ESSF dk1/dk2/wm / MS dk only) LU 22 (ESSF dk1/dk2 / MS dk only)	
Intermediate Biodiversity Emphasis Areas	265,909	110,134	Old Seral Goals: LU 7, 8, 13-15, 19-20, 24-27, 29, 31-33 LU 10 (ESSFdk2, ICH only) LU 9 (ICH/MS only) LU 4 (PP only) LU 21 (MS only) LU 29 (IDF only)	
	23,668	13,685	Mature Seral Goals: LU 19 (MSdk only) LU 20, 24 (MS dk only)	
Low Biodiversity Emphasis Areas	193,851	102,720	Old Seral Goals: LU 3, 5, 6, 12, 18, 28, 30, 36 LU 4 (non PP) LU 9 (non ICH/MS) LU 10 (non ESSFdk2 /ICH) LU 21 (non MS) LU 29 (non IDF)	
	0	0	Mature Seral Goals: N/A	
Connectivity Corridor	205,329	107,510	Mapped Connectivity Corridors	
Caribou	12,169	2,969	Mapped Caribou Areas (Priority 1 and 2)	Designated by the HLPO (Oct 2002). Requirements exist to maintain old and mature forest for habitat.
Ungulate Winter Range	124,295	89,601	Mapped Ungulate Areas (KBLUP) with specific species associations (Mule Deer, White Tail, Moose, Elk).	KBLUP-IS and DM/DEO direction for 2002 FDP's. Requirements for mature forest exist.
Community Watersheds	19,364	5,217	Mapped Community Watersheds	KBLUP-IS, FPC. Water quality, quantify and timing of flow is to be maintained.
Domestic Watersheds	59,033	18,366	Mapped Domestic Watersheds	KBLUP-IS. Water quality, quantity and timing of flow is to be maintained.
Fire Maintained Ecosystem Restoration	14,759	11,033	Ecosystem Restoration Mapping provides management objectives in the NDT4 (Open Range / Open Forest / Managed Forest.	Designated by the HLPO (Oct 2002) with more detail in the KBLUP-IS.
Enhanced Resource Development Zone (ERDZ)	82,327	58,085	HLPO ERDZ Map	Designated by the HLPO (Oct 2002). Has reduced green-up guidelines to maximize timber production.
High Value Watersheds	37,468	17,593	Lussier Watershed (LU 5)	DM/DEO Designation

Visual Areas:	63,485	30,908	Mapped VQO polygons plus front / mid/ background viewing distances established from major highways/towns (as per KBLUP-IS Front Country Guidelines).	DM in letter dated Mar 14/03 established VQO's and referenced KBLUP-IS Front Country Visual Management Guidelines.
Integrated Resource Management	472,322	180,185	All areas outside of Open Range (FMER), Open Forest (FMER), and ERDZ areas.	Designated by the HLPO (Oct 2002). Has a min green-up guideline.

Areas within the TSA are often subject to several overlapping management objectives. For example, a stand in a High Biodiversity Landscape Unit may also be within an ungulate winter range area and a visually sensitive area. Overlapping objectives were modeled in a way that only allows stands to be harvested when all forest cover requirements have been satisfied. This involved the use of spatially unique 'zones' that were amalgamated into 'groups' that have forest cover requirements associated with them (FSSIM terminology).

3.2 Analysis units

To reduce the complexity and volume of information in the timber supply analysis, individual stands were aggregated into 'analysis units' based on dominant tree species (inventory type group), timber growing capability (site index), and silvicultural management regimes. For example, all spruce/balsam stands on moderate growing sites with a clearcut silviculture regime were grouped into a single analysis unit. Each analysis unit had an associated yield table that provided the model with the net merchantable volume available for harvest at various stand ages.

Three *sets* of analysis units were created to reflect the level of forest management associated with various time frames.

Existing Natural Stands (100 series – 185,528 ha of THLB)

Stands where forest management (planting/spacing) has been generally absent. This was defined as stands greater than 20 years old with no record of planting or spacing in the forest inventory files.

Existing Managed Stands (500 series – 48345 ha of THLB)

Stands where forest management (e.g., planting/spacing) has had a positive impact on the regeneration/growth of the stand. This was defined as stands harvested on or after 1982 (<= 20yrs old – 43,750ha) plus any stands harvested prior to 1982 that have records of planting or spacing in the forest inventory files (4595 ha). This set of analysis units was meant to capture past regeneration practices in the TSA that should provide at least a modest improvement over natural stands volumes. Once harvested in the model, these stands were grown with similar expectations to the future managed stands described below.

Future Managed Stands (200 / 600 series)

Stands harvested from today forward. Once existing natural stands were harvested in the model, they were assigned to one of these analysis units. They were meant to capture the management/regeneration practices occurring in the TSA today. The 100 series AU's regenerate into the 200 series AU's. The 500 series AU's regenerate into the 600 series AU's.

Table 21. Analysis Unit Descriptions: Existing Natural Stands and Associated Future Managed Stands

Analysis unit	Existing Natural Stands AU #	Future Managed Stands AU#	THLB Area (ha)	SI Inv Wtd Avg	SI SIBEC Wtd Avg	Variable used to define analysis unit			Rationale / Comments
						Inv type groups	Site index range	Slope range %	
FdPy, Py	101	201	1,431	14.3	17.1	6, 32	All	All	Shetlerwood outside OR and OF
FdOthers – Poor	103	203	10,956	12.4	17.8	1-5,7,8	<14	All	CC with Reserves
FdOthers – Mod	104	204	31,991	15.4	18.6	1-5,7,8	14 to <18	All	CC with Reserves
FdOthers – High	105	205	8,395	19.3	19.4	1-5,7,8	18+	All	CC with Reserves
SB – Poor	106	206	14,870	10.7	15.0	18-26	<14	All	CC with Reserves
SB – Mod	107	207	13,174	15.2	17.0	18-26	14 to <18	All	CC with Reserves
SB – High	108	208	4,316	19.8	19.0	18-26	18+	All	CC with Reserves
CH (All Sites)	109	209	334	15.4	16.0	9-17	All	All	CC with Reserves
Pl Poor – slopes 0-40%	110	210	5,339	12.0	18.1	27-31	<14	0-40	CC with Reserves – GB Harvest
Pl Mod – slopes 0-40%	111	211	24,539	15.7	19.0	27-31	14 to <18	0-40	CC with Reserves – GB Harvest
Pl High – slopes 0-40%	112	212	18,046	19.7	19.9	27-31	18+	0-40	CC with Reserves – GB Harvest
Pl Poor – slopes >40%	114	214	3,807	12.6	17.8	27-31	<14	>40	CC with Reserves – Cable Harvest
Pl Mod – slopes >40%	115	215	15,766	15.6	18.5	27-31	14 to <18	>40	CC with Reserves – Cable Harvest
Pl High – slopes >40%	116	216	7,033	19.4	19.2	27-31	18+	>40	CC with Reserves – Cable Harvest
Lw – Poor	117	217	2,716	12.0	17.5	33-34	<14	All	CC with Reserves / Seedtree
Lw – Mod	118	218	6,121	15.6	18.0	33-34	14 to <18	All	CC with Reserves / Seedtree
Lw – High	119	219	6,642	19.9	19.5	33-34	18+	All	CC with Reserves / Seedtree
FMER-OR	150	N/A	1,535	14.3	17.3	All	All	All	FMER Open Range - single entry
FMER-OF	151	251	8,570	13.8	16.4	All	All	All	FMER Open Forest - Part cut regime
Total			185,580						

Table 22. Analysis Unit Descriptions: Existing Managed Stands and Associated Future Managed Stands

Analysis unit	Existing Managed Stands AU #	Future Managed Stands AU#	THLB Area (ha)	SI Inv* Wtd Avg	SI SIBEC Wtd Avg	Variable used to define analysis unit			Rationale / Comments
						Inv type groups	Site index range	Slope range %	
FdPy, Py	501	601	571	12.7	16.7	6, 32	All	All	Partial Cutting Regime
FdOthers	502	602	8,851	16.3	18.8	1-5,7,8	All	All	CC with Reserves
SB	503	603	7,784	15.4	16.7	18-26	All	All	CC with Reserves
CH	504	604	85	17.4	17.4	9-17	All	All	CC with Reserves
Pl – Slopes 0-40%	505	605	25,135	16.2	18.2	27-31	All	0-40	CC with Reserves
Pl – Slopes >40%	506	606	4,543	16.1	17.6	27-31	All	>40	CC with Reserves
Lw	507	607	1,376	16.6	18.1	33-34	All	All	CC with Reserves / Seedtree
Total			48,345						

* Inventory base SI provided only for comparison – SIBEC SI's were used to model these AU's from time zero.

The FdPy/Py analysis units (101, 102) were intended to mimic the short term shelterwood regimes used on the hot, dry sites in the NDT 4. Overstory trees were retained to provide shade for seedling establishment but were then removed within 10 years – thus this regime was modeled as a clearcut with natural regeneration (VDYP curves). These AU's did not include areas mapped for Open Range or Open Forest ecosystem restoration treatments. Modeling details are provided in Table 23 with volumes shown in the graphs below and in Appendix F.

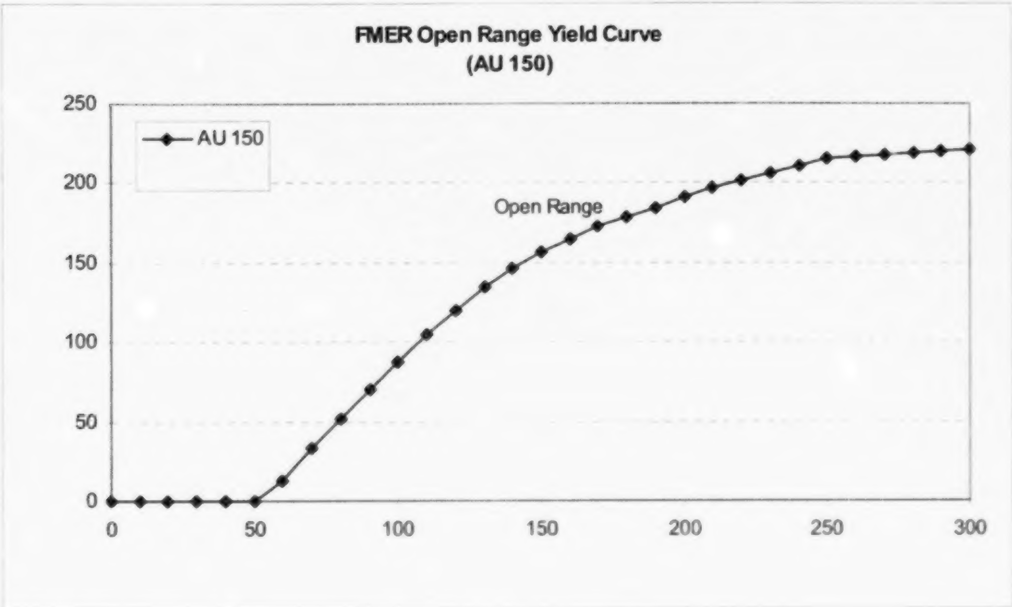


Figure 1. Open Range Ecosystem Restoration Yield Curve

The FMER-Open Range Analysis Unit (150) reflects a one time volume removal for ecosystem restoration purposes (Figure 1) where a small amount of mature volume (~20$^{m^3}$/ha) is retained on site. Excess volume is removed to restore these sites to historical stand densities and then frequent, low intensity fires are expected to maintain the open nature of these stands. Modeling details are provided in Table 23 with harvest volumes shown above and in Appendix F.

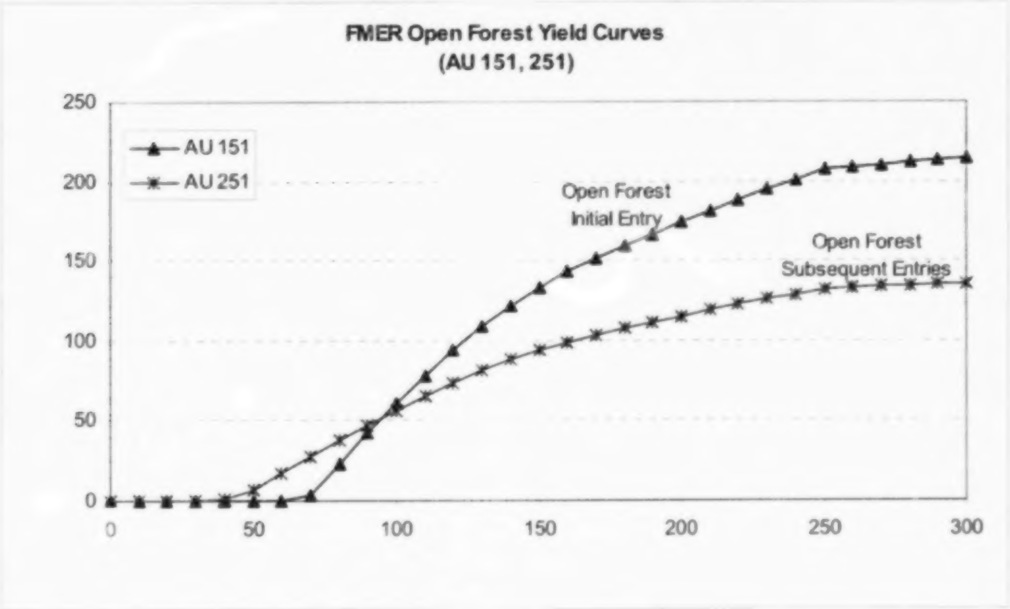


Figure 2. Open Forest Ecosystem Restoration yield cuves

The FMER-Open Forest Analysis Unit (151) reflects a commitment in KBLUP-IS and the HLPO to maintain a portion of the NDT4 in open forest conditions. This analysis unit was designated for an initial harvest that opens up these stands to historic densities, followed by periodic low volume harvests aimed at providing both range and timber. The first entry into these stands retains a 1/3 of the largest trees (~50$^{m^3}$/ha) and they were assumed to occupy 1/3 of the available growing space. The naturally regenerated future stands (AU 251) were thus modeled at 66% of the VDYP yields less factors for overstory shading and losses for roads. Shading reductions were calculated as 0.5% for each % of volume retained (33%x0.5=16.5%). The standard road loss of 5.8% was also applied. This resulted in a 49.5% total reduction from the regular VDYP curve for these sites. Modeling details are provided in Table 23 with volumes shown in the graph above and in Appendix F.

Table 23. Partial cutting modelling parameters

	Open Range Restoration	**Open Forest**		**FdPy Shelterwood**	
		Initial Entry	**2nd+ Entries**	**Initial Entry**	**2nd+ Entries**
Regular AU#	150	151	251	101	201, 501
Area	1585ha	9448 ha		1489 ha	
Min Harv Age	110 yrs	120 yrs	120 yrs	100 yrs	100 yrs
Stand Vol @ MHA *	124 ^{m3}/ha	144 ^{m3}/ha	126 ^{m3}/ha	112 ^{m3}/ha	106 ^{m3}/ha
Retention Volume *	20 ^{m3}/ha	50 ^{m3}/ha	50 ^{m3}/ha	0 ^{m3}/ha	0 ^{m3}/ha
Harv Vol @ MHA *	104 ^{m3}/ha	94 ^{m3}/ha	74 ^{m3}/ha	112 ^{m3}/ha	106 ^{m3}/ha
Re-Entry Cycle	n/a	n/a	every 120 yrs	n/a	every 100 yrs
MAI	1.13	1.20	0.62	1.12	1.06
Yield Model	VDYP	VDYP	VDYP	VDYP	VDYP
Modeled SI	14.3	13.8	13.8	14.3	14.3
Modeled CC	35%	55%	55%	55%	55%
Modeled Species	FdPyPlLwSe	FdPyPlLwSe		FdPyLwPl	
Yield Reductions Modeled:					
Partial cutting effect & Rds	N/A	0%	49.5%	0%	5.8%

The amount of Open Forest and Open Range harvested per year in the model was limited to 1/27th of the total area of the AU. This was to represent the achievement of ecosystem restoration treatments on all identified areas by 2030 – consistent with the "Blueprint for Action" document prepared by the Rocky Mountain Ecosystem Restoration Steering Committee (February 2000).

4.0 Growth and Yield

This section describes the information/data sources, assumptions, and methods for generating growth and yield estimates for both existing and future stands, under both unmanaged and managed conditions.

4.1 Site index

Estimates of site productivity were required in this analysis to predict the rate of growth that will occur on each site throughout the TSA. The height of a "site" tree at age 50 (measured at breast height) is one measure of site productivity and is commonly referred to as "site index".

4.1.1 Site curves

For each tree species, site curves were available to illustrate the relationship between stand height and age for a range of site indices. This analysis used the standard site curves recommended by the BC Ministry of Forests in all cases. They were as follows:

Table 24. Site index source

Species	Source
Douglas Fir (Fdi) + (Pw, Py, Lw)	Thrower and Goudie (1992)
Lodgepole Pine (Pl)	Nigh (1999)
Western Red Cedar (Cw)	Kurucz (1985)
Western Hemlock (Hw)	Nigh (1998)
White Spruce (Sw) + (Se, Sx, Bl)	Nigh (1997)

Note: Species surrogates as used in TIPSY are indicated by the "+ ( )" in the species column.

4.1.2 Site index adjustments

The Base Case included adjusted inventory site index values for managed stands (TIPSY curves) in recognition that existing inventory site indexes often do not adequately reflect the potential stand growth experienced by second growth stands. In the Invermere TSA, species such as Pl, Lw, Fd, and Sx have issues such as suppression, repression, and height growth damage that can underestimate SI in natural stands. In addition, significant areas of partially cut stands and uneven aged stands in the inventory could result in less accurate SI estimates. Many of these stands were assigned a single age and height in the inventory that may not always correlate well with site productivity estimates. Thus, in this analysis, all managed stand curves used adjusted site indexes where relationships were available. The current inventory file contains no ground based site index estimates (i.e., growth intercept data).

Site indexes were adjusted in five BEC variants using ecological relationships developed under the Site Index Biogeoclimatic Ecosystem Classification (SIBEC) project (MoF Research Branch). Predictive Ecosystem Mapping (PEM) completed for the TSA in Nov 2003 was used to identify ecosystems at the site series level. This PEM had an accuracy assessment completed on the ESSFdk1, MSdk, ICHmk1, IDFdm2, and PPdh2 in 2003 and these variants were approved for use in adjusting site index estimates in a Base Case analysis (email – Del Meidinger, Feb 13, 2004). In this approval, it was noted that the PEM was less useful for other interpretive ecosystem applications because of the large number of compound/complex site series calls and the low average accuracy for individual polygons (~53%).

When PEM based site series data was combined with forest cover data, SIBEC relationships were used to provide updated site index estimates for each stand in the forest cover file. These new estimates were used to build managed stand yield curves only. Harvest volumes for existing natural stands or site indexes used to define netdowns were unchanged.

SIBEC Application

The objective was to determine a new SIBEC influenced SI for each forest cover polygon and then calculate a weighted average SI for each Analysis Unit (THLB area).

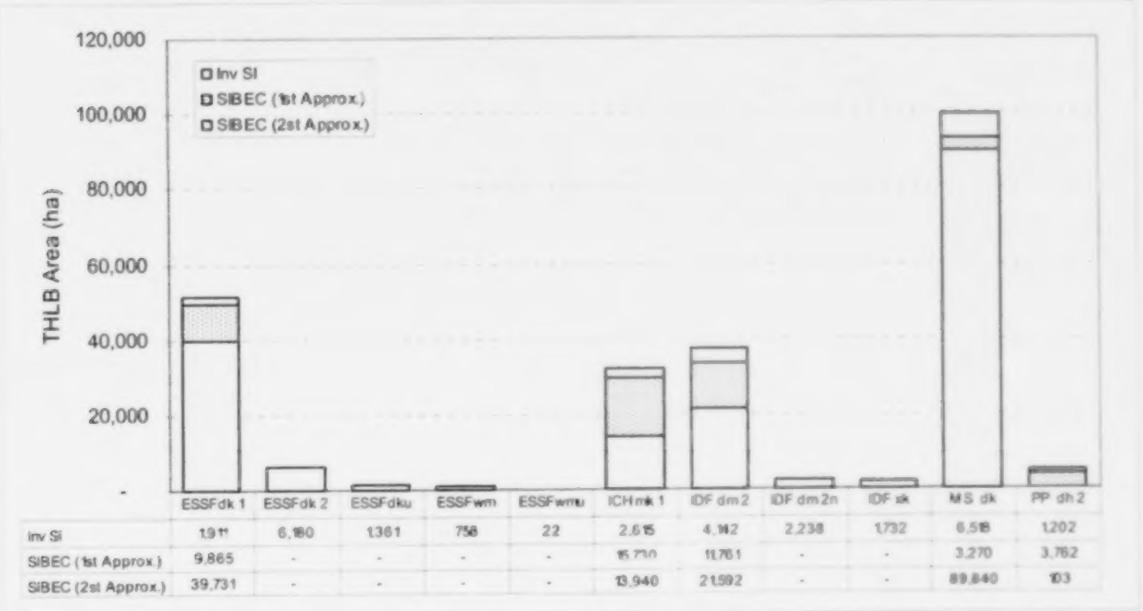
1. PEM and Forest Cover spatial data were unioned to get a single coverage that had all PEM and Forest Cover information (PEM/FC). This table was exported to an MS Access database.
2. A table with provincial SIBEC data (including the most recent December 2003 values for Invermere) was added to the Access database.
3. A table that listed the Site Series proportions for each PEM entity was compiled based on data from JMJ. This table was modified so that the 'Rock' proportions were re-assigned to the dominant forested Site Series. [Assumption is that if the forest cover says it was forested then the SI should be based on forested site series – NP areas within polygons are addressed in G&Y modeling process.]
4. The proportion table was used to determine an area of pure site series for each PEM/FC polygon. Based on leading tree species and site series, a SIBEC value was assigned. Where no SIBEC value existed, the inventory SI was used for that portion of the polygon.
5. A weighted average SI value for each PEM/FC polygon was calculated using the SI estimates and the polygon proportions.
6. A weighted average SI for each FC polygon was then calculated by rolling up the PEM/FC data to the FC polygon level. Each FC polygon in the TSR3 database was then assigned its new SIBEC influenced site index estimate. Thus the TSR3 dataset now had two site index columns – the original inventory estimate and the SIBEC influenced estimate.
7. A weighted average site index was then calculated for each AU using only THLB polygons. The site index value used in the calculation depended on the BEC variant of the polygon. The PEM accuracy assessment only addressed 5 BEC variants (ESSFdk1, ICHmk1, MSdk, IDFdm2, PPdh2) and thus only those BEC variants could utilize the new SIBEC influenced site index estimates. All others BEC variants utilized the inventory site index values.
8. Yield curves for current and future managed stands were modeled in TIPSY and utilized the SIBEC influenced SI's. Yield curves for existing natural stands were modeled in VDYP and utilized the inventory based SI's.

SIBEC Application Results

Weighted average site index values for each AU (Inventory and SIBEC influenced) can be found in Table 21 and Table 22. In general, the lower site index AU's had the largest increase, while the higher site index AU's remained the same or fell slightly. Overall, the average site index for the THLB area increased by 2.5m from 15.7m to 18.2m (+15.9%).

The three site indexes sources used to derive the new estimates are listed by priority below and are summarized by BEC variant in Figure 3.

1. SIBEC 2nd approximation estimates (69% of THLB area),
2. SIBEC 1st approximation estimates (19% of THLB area),
3. Forest Cover Inventory estimates (12% of THLB area).



	ESSFdk 1	ESSFdk 2	ESSFdku	ESSFwm	ESSFwmu	ICHmk 1	IDF dm 2	IDF dm 2n	IDF xk	MS dk	PP dh 2
Inv SI	1,911	6,180	1,361	758	22	2,615	4,142	2,238	1,732	6,518	1,202
SIBEC (1st Approx.)	9,865	-	-	-	-	15,730	11,761	-	-	3,270	3,762
SIBEC (2st Approx.)	39,731	-	-	-	-	13,940	21,592	-	-	89,840	103

Figure 3. Site index data sources by BEC variant.

4.2 Utilization level

Utilization levels define the maximum height of stumps that may be left on harvested areas, the minimum top diameter (inside bark), and the minimum diameter at breast height (dbh) of stems that must be removed from harvested areas. These factors were needed to calculate merchantable stand volume for use in the analysis.

Table 25. Utilization levels

	Utilization			
Species	**Minimum dbh (cm)**	**Maximum stump height (cm)**	**Minimum top dib (cm)**	**Firmwood standard (%)**
Pl	12.5	30	10	50
All Others	17.5	30	10	50

4.3 Decay, waste and breakage for unmanaged stands

Decay, waste and breakage factors are applied to unmanaged stand yield tables to obtain net harvest volumes per hectare. This analysis used the standard values incorporated into the Variable Density Yield Prediction (VDYP) model and area based on species, age and Public Sustained Yield Unit (PSYU).

4.4 Operational adjustment factors for managed stands

Operational Adjustment Factors (OAFs) were applied in order to adjust potential yields generated by the TIPSY growth and yield model down to net operational volumes. This included reductions for such things as gaps in stands, decay/waste/breakage, and endemic forest health losses.

There were two types of OAFs used in the TIPSY model. OAF 1 is a constant percentage reduction to account for openings in stands, distribution of stems or clumpiness, endemic pests and diseases, and other risks to potential yield. OAF 2 is an increasing percentage reduction that can be applied to account for decay, waste and breakage. OAF 2 is applied after OAF 1 and increases linearly over time from 0 percent at age 0 to the specified percentage at 100 years of age.

The OAF1 value used in this analysis was the provincial default of 15%.

The OAF2 value used in this analysis was the provincial default of 5% plus an amount to reflect losses from root disease (e.g., Armillaria). BEC variants and leading species were used to identify hazard ratings for Armillaria. Refer to Table 26.

Table 26. OAF2 Values

Leading Species	BEC Variants	Hazard Category	Additional OAF2 for Armillaria	Total OAF 2
Fd	Non ESSF	High	5.8%	10.8%
Pl	Non ESSF	Mod	3.7%	8.7%
Non Fd or Pl	Non ESSF	Low	0.0%	5.0%
All	ESSF	Low	0.0%	5.0%

A final OAF2 was calculated for each AU by determining the amount of area in each of the 3 risk categories (5.8%, 3.7%, 0% additional OAF2) outlined above and then calculating a weighted average. The additional OAF2 values used to address root rot were carried forward from the TSR2 analysis. The percentages reflect the proactive management occurring in the TSA to minimize losses. This consists of higher establishment densities and the planting of mixed species / lower risk species.

The OAF's described above were used to create net stand volumes for each of the managed stand analysis curves. These values were used to define minimum harvest ages through minimum harvest volumes and diameters. Additional volume reductions were applied to the 'stand' volumes to address future roads/trails/landings, future WTP's, and Identified Wildlife impacts. These final curves can be found in Appendix F and were used during modeling as 'effective' yields.

4.5 Volume reductions

Deciduous

Deciduous volumes are not currently utilized in the Invermere TSA. Thus, deciduous leading stands were removed from the THLB (see Table 12) and any deciduous volumes in coniferous leading stands were ignored during the compilation of yield curves. Recently logged blocks (<20 yrs old) with a deciduous leading inventory label were allowed to remain in the analysis because the coniferous stems are likely to overtop the deciduous stems and form the next crop. Deciduous stems in future managed stands were treated as 'holes' in the stand and are addressed by the application of the OAF1 reduction. Stocking of coniferous in future managed stands was actually higher than modelled - see section 5.1.

Whitebark pine

Whitebark pine (Pa) leading stands in the TSA have experienced significant mortality in recent history. Because this mortality was not captured in the inventory files and much of the remaining stands are generally unmerchantable, Pa leading stands were removed from the THLB (see Table 12). Where Pa forms a minor component of existing stands, its volume was left in the analysis because current practice is to log these stems when they are part of better quality stands.

Partially Logged Stands in the Inventory

A history of partial logging in the TSA has resulted in the forest inventory file containing a number of areas with a % disturbed indicator. The VDYP yield model likely overestimated the volumes associated with these stands, as it was insensitive to the attributes used to describe the changes in these stands. The following was done to address the issue:

> Stands slated for partial cutting regimes in the NDT4 (FdPy, Open Range, Open Forest), had volume estimates determined based on professional judgment supported by modeling. Historical partial harvesting in these stands was one of the many considerations during the determination of these volumes. Partial harvesting was assumed to continue on these sites.

Partially harvested stands outside of the NDT4 are typically stands that were logged of their largest stems (IU logging) and stands that had "pine only removal" treatments. It is very unlikely that these stands will be partially harvested again. The majority of the area meeting this description was logged prior to the most recent reinventory (1994/95 photos), thus the inventory attributes now reflect the residual stands as much as possible. Where high removals (60+%) occurred it appears that the attributes on the inventory file now reasonably reflect the new stand. Issues still exist when low to moderate volume removals left stands that were still dominated by trees from the original stand. This translated into inventory attributes that do not adequately reflect the volume loss on the site. For these stands, the level of disturbance (10%, 20%, 30%, etc.) was used to reduce the stand volume generated from VDYP. For example, a site with a 20% disturbance in its history had its VDYP volume reduced by 20%. These stand level adjustments were reflected in the yield curves.

4.6 In-Block volume retention

Retention of merchantable volume in the form of patches and individual trees is a common practice within cutblocks in the Invermere TSA. Volume is retained to meet wildlife tree requirements and for a variety of other forest management considerations (visuals, UWR, seedtrees, beetle proofing, etc). The amount and location of this retention can directly affect timber supply. Where volume is left in the THLB, and there is no expectation to remove it before the start of the next rotation, it must be accounted for in the timber supply model as a yield reduction.

A study was initiated in an effort to quantify the amount of volume being retained in recently logged blocks in the Invermere TSA so that appropriate volume implications can be included in the DFAM Timber Supply Review (TSR3). The detailed report on this study was published as *Invermere Timber Supply Area In-Block Volume Retention Study FINAL March 19, 2004*. Based on the results of the study, a volume reduction of 3.5% was recommended for application in the Invermere TSR3 Base Case model to account for Wildlife Tree Retention and all other types of long term stand level retention.

This value is based on the 7.3% THLB retention identified in the study with the following reductions applied to address the six potential areas of overestimation:

- 25% reduction to account for lower volumes in WTPs (7.3 * 75% = 5.5%)
- 1.5% reduction for overlaps with vets, OGMAs, and undetectable NTHLB (5.5% - 1.5% = 4.0%)
- 0.5% reduction for improved / different practices occurring into the future (4.0% - 0.5% = 3.5%)

These reductions are based on professional judgement and familiarity with both this study and the TSR3 model. For additional context, the GIS analysis that looked specifically at WTP impacts for TSR3 resulted in a 1.6% impact estimate. That analysis likely provides us with a theoretical minimum or lower bound on the in-block retention impact. The raw result of this study (7.3% impact) could be viewed as a potential upper bound on this impact, with the recommended value (3.5%) falling in between.

4.7 Other issues related to yield table development

Yield tables were derived for existing natural stands using VDYP Batch v6.6d. A yield table was generated for each polygon and then aggregated into one table for each AU. Volume reduction factors were applied to specific polygons as described elsewhere in this document (e.g., partially logged stands, Backlog NSR stands with low volume expectations).

All future managed stand AU's had an associated existing stand AU from which it will inherit stands when they are logged. These future managed stand AU's used the area weighted site indexes from the appropriate existing stand AU's and the regeneration assumption outlined in this document. These values were input into TIPSY 3.0h to generate a yield curve for each AU. All final yield tables are included as an appendix to the final analysis report.

4.8 Existing Timber Volume Check

To verify that no errors were made in aggregation and that no significant aggregation bias exists, the total volume of the current (starting) inventory using polygon-specific inventory volumes was compared to the total volume of the current inventory based on analysis unit volumes. The results for existing natural (VDYP) AU's are shown in Table 27. The table shows a poor correlation between the AU and inventory volumes for partially cut AU's (101,150,151) because the AU volumes only reflect the volume available for harvest (subset of stand volume) while the inventory volumes reflect full stand volumes.

Table 27. Existing timber volume check

AU	THLB Area (ha)	Volume derived from:		Difference		Comments
		Inventory	Yield tables (AU)*	m^3	%	
101	1,489	155,572	172,563	16,991	11%	
103	11,861	1,511,702	1,539,303	27,601	2%	
104	32,115	5,103,646	5,397,281	293,635	6%	
105	8,395	1,640,356	1,640,551	195	0%	
106	14,870	3,965,693	3,822,725	-142,968	-4%	
107	13,174	1,890,888	1,812,273	-78,615	-4%	
108	4,316	892,093	853,913	-38,180	-4%	
109	334	29,765	34,416	4,652	16%	
110	6,585	887,628	909,445	21,817	2%	
111	25,257	3,701,373	3,841,487	140,114	4%	
112	18,046	3,833,641	3,928,967	95,326	2%	
114	3,983	744,383	773,682	29,299	4%	
115	15,935	3,080,871	3,186,121	105,250	3%	
116	7,033	1,564,435	1,619,624	55,189	4%	
117	2,736	437,975	441,546	3,571	1%	
118	6,121	1,075,776	1,093,071	17,295	2%	
119	6,642	1,182,117	1,178,305	-3,812	0%	
150	1,585	77,290	54,525	-22,764	-29%	AU yields only represent volume available for harvest.
151	9,448	565,146	338,626	-226,520	-40%	
All VDYP	**189,926**	**32,340,352**	**32,638,425**	**298,073**	**0.9%**	93% of the THLB.
VDYP - no PC	**177,403**	**31,542,343**	**32,072,710**	**530,367**	**1.7%**	**AU yields are higher than inventory volumes by <2%**

* Actual yields used in the model were lower because of reductions for WTP's and historical partial cutting adjustments. The volumes reported here are meant to be consistent with the inventory volumes reported for each polygon.

TIPSY AU's are not shown here because volume comparisons with VDYP have little value. Overall, the volumes being generated from the AU yield tables correlated well with the inventory (<2% difference).

5.0 Silviculture

5.1 Silviculture management regimes

After harvest, stands in the TSA follow various silvicultural management regimes depending on originating stand type. Some stand types rely on natural regeneration while others rely on planting or a combination of the two. This section of the data package summarizes the silvicultural management inputs used in the TIPSY growth and yield model for each managed stand AU. In this analysis, current practices were reflected in the Future Managed Stand AU's (200 series) found in Table 28, while average historical regeneration practices were reflected in the Existing Managed Stand AU's (500 series). When existing managed stands were harvested, they moved onto an additional set of future managed stand AU's (600 series) that were identical to the 500 series but reflected the genetic gains for future managed stands.

Table 28. Regeneration Assumptions

Analysis Unit #	Regeneration Method and Weighting (%)	Regenerating Species and Weighting (%)	SI	Initial Density (stems/ha)	Regen Delay (years)	Comments
Future Managed Stands						
201	Natural 100%	$Fd_{85}Py_{10}Lw_5$	17.1	N/A	N/A	Modeled as a shelterwood system with overstory removal within 10 yrs – natural regeneration assumed.
203	Natural 5% Planted 95%	$Fd_{60}Pl_{30}Lw_5Sx_5$ $Fd_{55}Pl_{40}Sx_5$	17.8	2500 1800	1 1	Advanced regeneration is partially kept. Fill planted with a variety of species.
204			18.6			
205			19.4			
206	Planted 100%	$Sx_{60}Pl_{35}Bl_5$	15.0	2200	1	Sx/Bl stands.
207			17.0			
208			19.0			
209	Planted 100%	$Sx_{50}Lw_{40}Cw_5Pl_5$	16.0	2200	1	Cw/Hw stands
210	Natural 10% Planted 90%	$Pl_{80}Fd_{10}Sx_{10}$ Pl_{70} $Fd_{15}Lw_{10}Sx_5$	18.1	2500 1800	1 1	Pine ground based harvest has more disturbance and more natural regeneration.
211			19.0			
212			19.9			
214	Natural 5% Planted 95%	$Pl_{80}Fd_{10}Sx_{10}$ Pl_{70} $Fd_{15}Lw_{10}Sx_5$	17.8	2500 1800	1 1	Pine cable harvest has less disturbance and less natural regeneration.
215			18.5			
216			19.2			
217	Natural 5% Planted 95%	$Lw_{30}Pl_{25}$ $Fd_{25}Sx_{10}Bl_{10}$ $Lw_{60}Pl_{20}$ $Sx_{10}Fd_5Bl_5$	17.5	1400 1200	1 1	
218			18.0			
219			19.5			
251	Natural 100%	$Fd_{85}Py_{10}Lw_5$	16.4	N/A	N/A	FMER Open Forest – modeled as uneven age stand with periodic volume removals.
Existing Managed Stands						
501	Natural 100%	$Fd_{85}Py_{10}Lw_5$	16.8	N/A	N/A	FdPy, Py AU's
502	Planted 100%	$Pl_{53}Fd_{35}Lw_{10}Sx_2$	18.8	2200	3	FdOthers AU's
503	Natural 35% Planted 65%	$Pl_{79}Lw_{21}$ $Pl_{69}Sx_{25}Lw_5Bl_1$	16.7	2400 1600	2 3	SxBl AU's
504	Planted 100%	$Lw_{59}Pl_{33}Sx_8$	17.4	2200	3	CwHw AU's
505	Natural 30% Planted 70%	$Pl_{68}Bl_{10}Lw_{10}Fd_{10}Sx_2$ $Pl_{82}Sx_8Lw_8Fd_1Bl_1$	18.2	2800 1800	2 3	Pl – Slopes 0-40% AU's
506	Natural 25% Planted 75%	$Pl_{68}Bl_{10}Lw_{10}Fd_{10}Sx_2$ $Pl_{82}Sx_8Lw_8Fd_1Bl_1$	17.6	2800 1800	2 3	Pl – Slopes >40% AU's
507	Natural 20% Planted 80%	$Pl_{76}Fd_{24}$ $Pl_{60}Lw_{33}Sx_4Fd_2Bl_1$	18.1	1400 1200	2 3	Larch was generally not planted before 1995.

In general, existing managed stands had longer regeneration delays, higher reliance on natural regeneration, and less planted Lw than the future managed stands. This reflected the range of practices that have occurred from 1982 to present[7]. Future managed stand inputs were more optimistic because current day practice is to aggressively restock areas through timely planting and utilization of select genetic stock (i.e., Pl, Sx, Lw).

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[7] The natural/planted percentages, stocking densities, and species distributions were based on data summarized out of ISIS (SIA) from 1982 to 2002.

The initial stocking densities shown in Table 28 represent the density of the stand layer that will form the next crop. The intent was to identify the density of future crop trees that are competing for light, space and nutrients at the time of free growing declaration – all other stem layers are not considered because they are not relevant in the growth model. These densities were estimated after reviewing ISIS total stocking and well-spaced densities and conducting discussions with government and licensee silviculture staff about local regeneration dynamics.

Another factor considered during the development of the initial stocking densities was the fact that densities are likely to fall as stands move out of the plantation stage because there is often some level of mortality related to plantation forest health issues (root rot, rust, weevils, etc). Additional density on these sites acts as a safety net ensuring that plantations maintain critical minimum stocking levels. TIPSY does not remove stems for forest health reasons (it only alters volumes) so it was important that initial densities provided to the model reflect the number of healthy competitive stems in the future crop layer.

5.2 Regeneration delay

Regeneration delay is the time between harvesting and the time when stand growth begins. The delay incorporates both the time taken to establish a stand, and the age of seedling stock planted, if applicable. For this analysis, regeneration delay was addressed separately for existing managed stands and the future managed stands.

Existing Managed Stands:

For existing managed stands, regeneration delay was addressed through the use of actual stand age in the forest inventory file. This age represents the actual age of the stand and not the time since harvesting. For example, a stand may have been harvested 15 years ago but the current stand age is 12 – this implies a 3 year regeneration delay). The use of actual ages eliminated the need to estimate an average regeneration delay for these stands.

Future managed Stands[8]:

For planted sites, current practice in the Invermere TSA is to plant the year following harvest with one year old stock (i.e., no regeneration delay). There are some sites that are not restocked this quickly due to plantation failures, seedling delays, or general logistics. Because of this small amount of area, the actual regeneration delay is somewhere between 0 and 1 year. For the purpose of this analysis, a one year regeneration delay was used for future planted stands. Statistics gathered from ISIS[9] support this logic because the average regeneration delay for planted stands over the last 6 years is less than 0 – indicating the presence of acceptable advanced generation on many sites.

Current practice also utilizes natural regeneration on a small amount of sites where it is well advanced and in good condition. In these cases the regeneration delay is often non-existent because the stand is already stocked after harvest. A regeneration delay of one year was used for naturally regenerated future managed stands. Statistics gathered from ISIS support this logic because the average regeneration delay for these stands is at least –15 yrs in all AU's. This does not infer that all future crop trees are on site one year after harvesting takes place, but does assume that there are many sites that are well advanced after harvest (negative regeneration delay) and some that take longer to come on line (positive regeneration delay). On balance, the regeneration delay for these sites is well below zero. To be conservative, the analysis used a regeneration delay of 1 year for naturally regenerated stands.

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[8] As per "Determination of Regeneration Delay for Invermere and Cranbrook TSA's", Oliver Thomae, Mar 1, 2004.

[9] To determine regeneration delay, the Silviculture Information Access database was queried for stands harvested, regenerated and satisfactorily restocked since Jan. 1, 1996, (approximating introduction of the Forest Practices Code). Silviculture surveys conducted during this time would have been done in accordance with the Silviculture Surveys Guidebook. The guidebook outlines procedures for stocking surveys including discerning acceptable advanced regeneration, entering multistoried stand information, and describing the silviculture layer. The silviculture layer is to be composed of only acceptable and preferred well-spaced trees. To assign the appropriate regeneration delay to each analysis unit, the data was queried using the leading previous stand species, and the distribution of resulting silviculture layer species was noted. The average age of all silviculture layers (in the case of multistoried stands) was extracted in the query. Multi-storied silviculture layers are to be noted only where they have over 6% crown closure according to the guidebook. Layers with less than or equal to 6% crown closure are classed as veteran and are not included in this average. Regeneration delay was then calculated by subtracting the disturbance date from the reference year less average age of all silviculture layers.

These regeneration delays differ from TSR2 (2yr natural, 3yr planted) for several reasons. TSR2 grouped existing and future managed stand together and therefore had to consider historical regeneration practices in the TSA when setting regeneration delays. Historical practices relied more heavily on natural regeneration and planted fewer sites. In addition, planting is pursued more aggressively now relative to TSR2. Licensees routinely order stock prior to harvesting to minimize any delays and are planting more sites/species in order to reduce green-up time and capitalize on the genetic gains associated with 'A' class seedlings. Thus, average regeneration delays applied to the entire block of managed stands in TSR2 were higher than what were used in this analysis.

Regeneration delays for future managed stands were incorporated into FSSIM through assignment of negative ages after harvesting. For example, after a stand is harvested it would be assigned an age of -1 in order to reflect a 1 year regeneration delay. This results in the stand waiting one year before starting to grow on the yield curves utilized in the model.

5.3 Stand rehabilitation

No stand rehabilitation is currently occurring in the TSA. No rehabilitation of problem forest types or non merchantable types was modeled.

5.4 Gene resources — use of select seed

As required by the Forest Practices Code, the TSA uses the best genetic quality seed and vegetative material available for regeneration. This section describes the yield adjustments used in this analysis to account for the use of select seed (i.e., orchard & select provenance seed with a known genetic gain as measured by Genetic Worth [GW]). Seed planning units (SPU's) are used to track the genetic worth and use of different seedlots. The select seed SPU's that occur within the Invermere TSA are as follows:

Table 29. Seed Planning Units within the Invermere TSA (Class A Seed).

SPU	Gross Area within TSA (ha)	Min Elev. (m)	Max Elev. (m)	**Class A Seedlings Requested in 2003**	**Actual Genetic Worth % Achieved in 2003***	**Projected Future Genetic Worth % (2013)**
FD EK ALL	102,656	1	1500	-	0%	0%
LW EK ALL	55,471	800	1500	675,000	4%	14%
PLI EK HIGH	278,251	1500	2000	-	0%	0%
PLI EK LOW	372,049	1	1500	1,828,300	3%**	12%
PLI NE HIGH	63,183	1400	2000	-	0%	0%
PW KQ ALL	1,663	400	1400	-	0%	0%
SX EK ALL	112,201	1	1700	656,100	18%	26%

* Values obtained from SeedMap report titled "Genetic Gain: Report 1 – Genetic Worth of Seedlings Requested by Species and SPZ" and filtered to the Invermere TSA.

** Pl GW of 3% is from B+ seed available to the TSA (Rocky Mtn Trench – Cartwright) for sites under 1475m.

Historical use of select seed was obtained from the Ministry of Forests Seed Planning & Registry system (SPAR) – SeedMap summary reports. This information was used to derive net genetic gain estimates (Net GW) at the species level (Table 30) for use during modeling of existing and future managed stand yields. Table 30 illustrates the weighted average GW for each species for the last six years [A], the percent select seed use for each species in the TSA [B], and the Net GW for each species [C]. The Net GW was calculated by multiplying [A] x [B] and is graphed in Figure 4.

Table 30. Calculation of net genetic worth by species in the Invermere TSA.

	Wt Avg* GW by Species (Class A) [A]				% Class A of Total Seedlings Planted [B]				Net GW by Species [C]			
Year	Fd	Lw	Pl	Sx	Fd	Lw	Pl	Sx	Fd	Lw	Pl	Sx
1998	0%	0%	3%	8%	0%	0%	31%	83%	0%	0%	1%	7%
1999	0%	0%	3%	8%	0%	0%	31%	61%	0%	0%	1%	5%
2000	0%	3%	3%	17%	0%	68%	31%	58%	0%	2%	1%	10%
2001	0%	3%	3%	15%	0%	73%	31%	78%	0%	2%	1%	12%
2002	0%	2%	3%	21%	0%	93%	31%	69%	0%	2%	1%	14%
2003	0%	4%	3%	18%	0%	85%	31%	79%	**0%**	**3%**	**1%**	**14%**
5 yr Avg	0%	2%	3%	15%	0%	53%	31%	71%	0%	2%	1%	10%
20 yr Avg	0%	1%	1%	4%	0%	16%	11%	21%	**0%**	**1%**	**0%**	**3%**

* Weighted average was based on the amount of seed requested from each class "A" SPU occurring in the TSA and its genetic worth (SeedMap Genetic Gain: Report 1 – Genetic Gain of Seedlings Requested by Species and SPZ). The Pl GW is based on B+ seedlots.

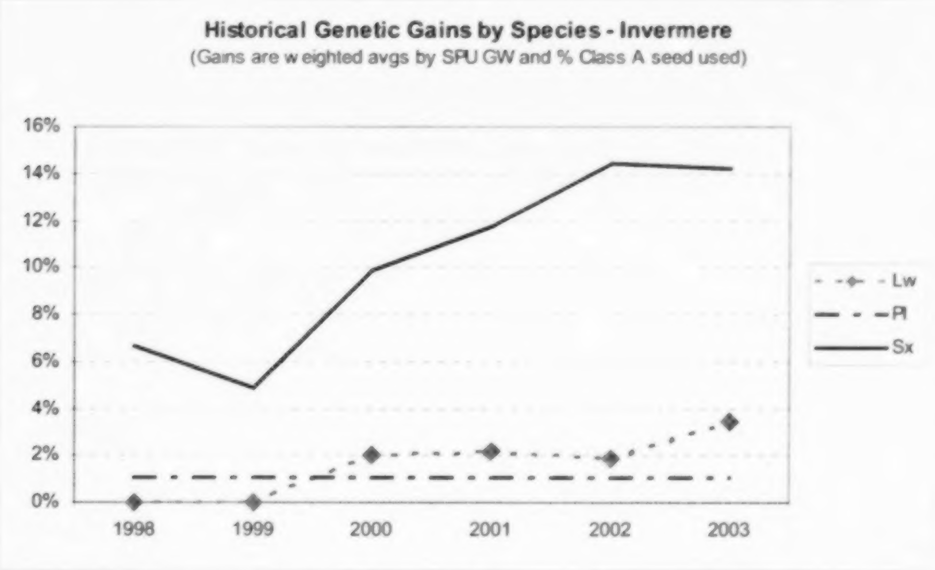

Figure 4. Net Genetic Worth for All Seedlings by Species - Invermere TSA

The application of this data in the timber supply model is summarized in Table 31 and described below.

In the Base Case, the 20 year historical averages from Table 30 was applied when modeling existing managed stands because this best corresponds with the criteria used to define these stands. When generating the AU yields in TIPSY for these stands, larch will have a 1% GW applied while spruce will have a 3% GW applied. These values were lower than those applied to future managed stands because the GW realized on present day stock is watered down by historical use of stock with no genetic gain. Future managed stands will have the 2003 Net GW's for Sx (14%), Pl (1%), and Lw (3%) used in the Base Case.

No adjustment of genetic gains was scheduled during the planning horizon.

A sensitivity analysis explored the implication of applying forecast 2013 GW's based on projected orchard gains and projected seed availability (orchard production) for Sx, Pl, Lw, and Fd. The projected Net GW for each species was based on the values shown in Table 29 (prorated by THLB area) and considered select seed availability as projected in the SPU timelines provided by Tree Improvement Branch. Genetic gains associated with existing managed stands remained unchanged in the sensitivity analysis.

Genetic gains were incorporated into the growth and yield curves through TIPSY model functionality. When a species identified in Table 31 was included in a managed stand AU, its associated Net GW was input into TIPSY. This Net GW reflects the genetic gain associated with all seedlings of a given species planted in a typical year. Where surrogate species were used in TIPSY, the GW employed is prorated to reflect the relative GW's of the original species (Sx used for Bl but Sx Gw not applied to Bl proportion)

Table 31. Net genetic worth by species to be applied in timber supply model

Time Horizon in Model (decades)	**Species**	**Genetic Gains applied in TIPSY For Base Case**		**Genetic Gains applied in TIPSY for Sensitivity Analysis**	
		Existing Managed Stands	Future Managed Stands	Existing Managed Stands	Future Managed Stands
1-25	Fd	0%	0%	0%	0%
1-25	Lw	1%	3%	1%	14%
1-25	Pl	0%	1%	0%	4%
1-25	Sx	3%	14%	3%	24%

5.5 Silviculture history (defining existing managed stands)

As discussed in the Analysis Units section above, existing managed stands were defined as those stands regenerated from 1982 forward (currently <=20 yrs old) plus any older stands with a record of planting or spacing in the forest inventory file. The 1982 date corresponds with the time period where silvicultural management regimes were regularly utilized in the TSA (legal obligations to reforest) or management regimes were applied to clean up earlier harvesting (Industry outstanding stands were addressed). Through funding sources such as FRDA (1&2), FRBC, and FIA, the vast majority of the older plantations in the TSA have been assessed and treated where necessary. Large areas were spaced in the early 1990's.

Both future managed stands and existing managed stands were modeled using TIPSY utilizing the inputs shown in Table 28. The initial densities shown in these tables reflect the economic realities that limit spacing now and into the foreseeable future. Spacing treatments are being carried out to avoid repression but no attempt is being made to manage densities to target stocking levels. In recognition of this, higher densities than target stocking were modeled in TIPSY for many AU's.

5.6 Backlog and current not satisfactorily restocked areas (NSR)

Backlog NSR is any area that was denuded prior to 1987 (when basic silviculture became the obligation of licensees) and is not yet fully stocked. All other NSR areas are considered current NSR.
Current NSR was assigned to existing managed stand analysis units and any delay in restocking these sites was reflected in the regeneration delay's assigned to these analysis units. These sites have either been reforested but are not yet confirmed in the inventory file, or will be reforested because licenses are under a legal obligation to do so.

Backlog NSR was discussed with District silviculture and planning staff. Based on reviews done by District staff following TSR2, most of the NSR on record at that time was reclassified due to non-crown ownership, open range, inoperability, or other factors. The current estimate of Backlog NSR from district silvicultural data (ISIS / SIA) is 1546 ha. District staff (Lynn K, MoF RMFD, Pers Comm, Oct 2003) indicated that about half of this area should be maintained in the working land base, while the other half should be removed because of factors that make it infeasible to restock these areas (shallow soils, extensive exposed rock or talus, excessive debris, inaccessible, too small to treat, to expensive to treat, etc). To spatially identify areas that would be removed from the timber harvesting land base, backlog NSR openings numbers were extracted from ISIS/SIA and the following areas were selected for removal: old burns and any areas classed as non-plantable. These sites represent 965 ha or 62% of the total backlog NSR area.

The area of backlog NSR that is to remain in the working land base (581 ha) was assigned an age of zero and incorporated into the appropriate existing natural stand analysis units with a 40% volume reduction (based on professional judgment, Forsite 2003). These sites currently have partial stocking, and are expected to gradually fill-in. This lag time to attain minimum stocking levels would be partially offset by the discounting of the advanced stocking on these sites, but lower volumes are still expected.

Table 32. Backlog and Current NSR

NSR Type	Area to Remain in THLB	Netdown Area (Non THLB)	Total Area in ISIS (ha)
Current NSR	6,101	0	6,101
Backlog NSR	581	936	1,546
Totals	6,682	936	7,647

The current NSR noted above, along with areas of backlog NSR expected to be restocked, are also subject to netdowns for riparian, steep ground, low site index and other netdown factors which are applied to the TSA.

6.0 Unsalvaged Losses

The purpose of this section is to quantify the average annual volume of timber that, in the future, will be damaged or killed on the THLB and not salvaged or accounted for by other factors. These losses are due to a number of factors that cause tree mortality, including insects, disease, blowdown, snowpress, wildfires, etc. This factor is meant to capture catastrophic natural events like the fires that occurred in the Invermere TSA in 2003. Endemic pest losses are dealt with through factors applied in the growth and yield models as noted below:

> **TIPSY:** Operational Adjustment Factors reduces gross volumes to account for losses toward maturity such as decay, and endemic forest health issues like minor infestations.
> **VDYP:** The model predicts actual average yields from appropriate inventory ground plots. Endemic losses are inherently recognized in the model data.

The annual unsalvaged losses determined in TSR2 are still considered valid and were used in this analysis where no new data are available. The Ministry of Forests provided updated values for Mountain Pine beetle and Douglas-fir Beetle based on data from 1976-2003. The 2003 fires are not included in the wildfire estimates but they have been dealt with directly in the model as described in Section 6.1.

Table 33. Unsalvaged losses

Description	Annual unsalvaged volume in the THLB (m^3/year)
Mountain pine beetle	15,673
Spruce bark beetle	38
Douglas-fir bark beetle	307
Balsam bark beetle	302
Dwarf mistletoe	1,763
Catastrophic blowdown / snowpress (mature stands)	330
Non catastrophic in-block blowdown / snowpress (immediately adjacent to logged stands)	5
Non catastrophic blowdown / snowpress (immediately adjacent to roads)	27
Wildlifes	5,882
Total	24,327 ^{m3}

The losses shown above are based on merchantable volume losses. Losses associated with immature stands also impact the rate at which timber becomes available in the TSA but little data are available to estimate the extent or impact of these losses. These disturbances are captured during periodic inventory updates and are therefore reflected in subsequent TSR's. Treatment of these stands within the 2003 fires is described in Section 6.1.

Unsalvaged losses were implemented in FSSIM by adding 24,327 ^{m3}/yr to the desired harvest requested for each decade, and then subtracting the 24,327 ^{m3}/yr from the forecast for reporting. This resulted in an estimate of timber supply available for human use and ensured that natural disturbances were modeled inside the working land base. Natural disturbance outside of the working land base is addressed in Section 7.5.1.1.

6.1 Treatment of 2003 Fires

The fires of 2003 impacted considerable area of the CFLB in the Invermere TSA and has resulted in a significant salvage effort. Table 34 and Figure 5 below provide details on the area and volume impacted. Within the THLB, a total of 1,895 ha were included in the mapped fire boundaries.

Table 34. 2003 Fire Area and Volume Summary

	Forest District		THLB	
FIRE	**Area (ha)**	**Coniferous ^{m3}**	**Area (ha)**	**Coniferous ^{m3}**
Bear Creek	97	15,147	0	35
Hot Creek	485	69,329	0	41
Joffe Creek	209	39,564	0	0
Magnesite Creek	3543	572,206	266	82,362
Middle Fork/White River	10587	2,072,018	1,591	321,122
Venables	4711	244,432	37	6,801
Fire Totals	19,631	3,012,695	1,895	410,362

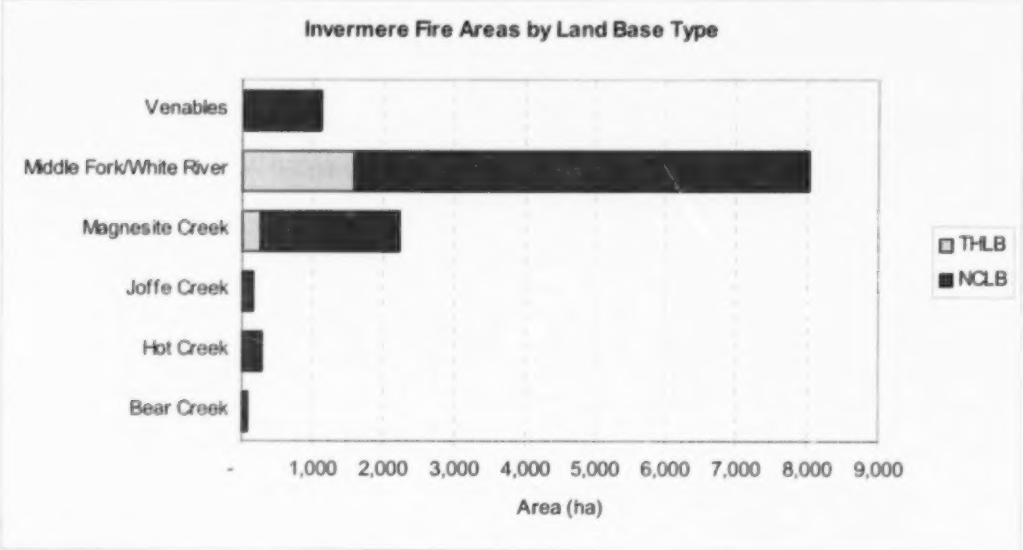

Figure 5. 2003 Fire Volume by Land Base Type

For modeling purposes, the following was applied in the Base Case:

- The burnt areas within the fire boundaries was assigned to a set of AU's (9000 series) that mimic the standard AU's but will allow the application of volume reductions in FSSIM. The size of this reduction (20%) was determined based on licensee salvage efforts to date (CP's cruised before the fire were used to compare before and after volumes). Licensees have also confirmed that less than 1% of the fire areas remain as green timber - this was not captured in the model.
- In order to recognize that the fire will have created new non-productive areas, the productive area within the fire has been reduced by 10% in the timber supply model.
- Fires salvage areas was assigned the highest harvest priority. Any areas harvested in the model was given a 2 year regen delay and assigned to standard managed stand AU's. The amount of salvage harvesting allowed to occur in the first 3 years of the planning horizon was limited to the volume expected to be salvaged by licensees (326,000 ^{m3}, ~1676 ha). This estimate takes into account reduced volume expectations from the fire.
- All fire salvaged stands were assumed to regenerate to managed stand yields.
- After two years, any burnt stands that were not salvaged will be regenerated naturally. These stands will be transferred to standard natural stand AU's with an age of –2 (four-year regen delay).
- All forest cover constraints were removed from the fire areas during salvage operations (first 2 years). This is consistent with operational practice as adjacency, VQO, UWR and ECA constraints are no longer relevant when timber is dead. The DM has approved cutting permits for large-scale salvage operations.

7.0 Integrated Resource Management

The range of timber and non-timber resource management zones that occur within the TSA were briefly outlined in section 3.1 of this document. This section of the document describes the forest cover requirements that are associated with these resource management zones.

Forest cover requirements are typically expressed as:

- a maximum amount of forest that can be younger than age X (or shorter than height Y);
- a minimum amount of forest that must be older than age W (or taller than height Z);

As discussed previously, these forest cover requirements can be overlapping within the TSA. The FSSIM model evaluates each requirement independently to ensure that the harvesting of a specific area is not violating any forest requirements.

7.1 Green-up/adjacency

The HLPO specifies different green-up requirements to be applied within the Invermere TSA. These requirements specify that a logged block must achieve a specific condition called green-up before adjacent areas can be logged. Green-up refers to the average height of the regenerating forest reaching a specified target. Green-up requirements can often be waived if licensees manage for patch size distributions specified in the HLPO and detailed in the Landscape Unit Planning Guide (MoF/MoE 1999). Modeling of green-up requirements was done using forest level objectives, as opposed to block specific objectives, because this was consistent with the operational flexibility afforded by patch size management. Green-up requirements and how they will be modeled are provided in Table 35.

Table 35. Green-up requirements by management zone

Management Zone	Green-up Requirement	Modeled Green-up Constraint	Area to which it applies
HLPO ERDZ Timber Zone	Successful regeneration (stocked)	Max 33% < 2 yr within each LU/ERDZ	THLB area inside the HLPO mapped ERDZ timber zone.
Fire Maintained Ecosystems – Open Range and Open Forest	None	None	Open Range and Open Forest areas (FMER mapping)
Integrated Resource Management Zone	2.5 m tall trees	Max 33% < 12 yrs within each LU/IRM	THLB area not included in the above 2 zones.

Age to green-up was determined by calculating a weighted average stand type for each of the zones and then evaluating the age/height relationship for the stand in SiteTools. The IRM zone was pine leading with an average site index (SIBEC) of 18.3 – giving an 11 yr green-up period. A one year regen delay was added to this value.

7.2 Visual resources

The District Manger of the Rocky Mountain Forest District established new Visual Quality Objectives (VQO's) with a letter to licensees on March 14, 2003 that also required consideration of Front Country Visual Management Guidelines outline in KBLUP-IS (sec 3.8). In this analysis, forest cover requirements aimed at meeting these objectives was applied so that the amount of younger stands that can occur in visually sensitive areas was limited.

The following procedure was used to model visual quality objectives:

1. All VQO polygons within Fd/Py Selection, Open Forest and Open Range AU's were anticipated to meet VQO's through partial cutting regimes and good visual design. No additional percent disturbance limits was applied to these areas.
2. VQO polygons where partial cutting regimes are not dominant (i.e., clearcut with reserves, seed trees, etc) had maximum planimetric percent disturbance values assigned based on VQO, visual absorption capability, and viewing distance from main corridors/towns (values provided in Table 36).

The viewpoints/corridors used were defined in the KBLUP-IS (Front Country Visual Management Guidelines).

Table 36. Visually sensitive areas: Maximum planimetric disturbance %'s

VQO	<1 km View Distance			1-5 km View Distance			5-12 km View Distance			>12 km
	Low VAC*	Mod VAC	High VAC	Low VAC	Mod VAC	High VAC	Low VAC	Mod VAC	High VAC	All VAC's
Preservation	0%	1%	2%	1%	2%	3%	2%	3%	5%	5%
Retention	3%	5%	7.5%	5%	7.5%	10%	7.5%	10%	15%	15%
Partial Retention	10%	12.5%	15%	12.5%	15%	17.5%	15%	20%	25%	25%
Modification	15%	17.5%	20%	17.5%	20%	22.5%	20%	25%	33%	33%

* VAC = Visual absorption capability

3. VQO polygons each had an area weighted average slope assigned and a "visually effective green-up" (VEG) height calculated according to Table 37 extracted from *Procedures for Factoring Visual Resources into Timber Supply Analyses (MoF 1998).*

Table 37. Tree heights required for meeting visually effective green-up by percent slope.

	Slope Class %'s											
	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-45	46-50	51-55	56-60	60+
Tree Height (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.3	8.5

4. Each VQO polygon had the resulting forest cover objective applied to its crown forested area in the model. For example, a VQO of Retention in the foreground with a VAC of High and an average slope of 32% would have the following objective: No more than 7.5% of the crown forested area in the VQO polygon can be under 6m tall.

The maximum disturbance percentages outlined in Table 36 were developed for use in the East Kootenay's by MoF District and Regional staff. They were believed to reflect current management in the TSA and reflect the use of good visual design during the development of cutting permits.

The visually effective green-up heights for each polygon were translated into green-up ages for use during modeling. Age to green-up was calculated in Site Tools using a weighted average stand type for all VQO polygons. Visually effective greenup ages ranged from 14 to 28 years and was based on a Fd stand with a site index of 17.9 (SIBEC based site index).

7.3 Recreation resources

Forest cover retention within important recreation areas in the TSA was addressed through the netdown process and the application of forest cover retention for other values. Miscellaneous reserves and recreation areas identified in the ownership file (coded 61 and 69) as under 100 ha were completely removed from the working land base (see Table 2). Those over 100 ha were not removed unless some other netdown factor removed them. On balance this removed an area considered representative of the area that would not be eligible for logging as a result of recreation (i.e., Forest Service recreation sites).

In addition, visually sensitive areas, riparian zones, caribou / UWR habitat areas, community/domestic watersheds, and lakeshore management zones on lakes over 5ha tend to overlap important recreation areas. The forest cover requirements on these zones accommodate recreational values. Thus, recreation resources did not have any specific additional forest cover objectives applied because other existing objectives were seen to adequately reflect current management for recreational values.

7.4 Wildlife

7.4.1 Ungulate winter range

Two sources of UWR data currently exist:

KBLUP-Implementation Strategy UWR: This UWR strategy was "made known" in 1998 and the most recent District Manager instructions for preparation of FDP's references this version of UWR. The current interpretations of its management objectives are listed below.

Table 38. KBLUP-IS UWR forest cover requirements

Snow Depth	Species	Forest cover objective*	Area of Application	Comments
Deep Snow Zone (defined as BEC zones other than PP or IDF)	Moose Whitetail Mule Elk	Min 50% >120 yrs Min 40% > 100 yrs Min 35% > 100 yrs Min 30% > 100 yrs	Crown forested area within each LU/BEC combination. Not FMER Open Range or Open Forest areas.**	The most limiting forest cover requirement was applied to polygons with multiple species listed.
Shallow Snow Zone (defined as PP or IDF BEC zones - ICH xm does not exist in Invermere)	Whitetail Elk Mule Moose	Min 30% > 100 yrs Min 25% > 100 yrs Min 25% > 100 yrs Min 40% > 81 yrs		

* As consolidated by Al Neal Oct 9, 2003.

* * Open Range and Open Forest areas identified in the Fire Maintained Ecosystem Restoration mapping will have no cover requirements applied because the primary objective in these areas is to produce forage.

PEM Based UWR: After TSR 2, a committee[10] was stuck to examine UWR management practices in the East Kootenay. The committee has developed an ecosystem based management strategy for UWR management with objectives for both landscape and stand level management. The committee's UWR mapping is based on capability ranking derived from a coarse Predictive Ecosystem Map (PEM). Management objectives are provided for various ecosystem types (i.e., open forest, open range, and managed forest units defined by moisture regimes).

Table 39. PEM Based UWR forest cover requirements

Habitat Type	Forest cover objectives	Area of Application	Comments
Open Range	None	Crown forested area within each LU by habitat type.	Habitat zones were derived from the EK PEM (not 2003 Invermere PEM).
Open Forest	None		
MF-Dry	10% > 100yrs		
Managed Forest -Transitional	20% >= 60 yrs, of which 10% > 100yrs 40% < 21 yrs		
Managed Forest -Mesic	30% >= 60 yrs , of which 20% > 100yrs 40% < 21 yrs		
Managed Forest -Moist	20% >= 60 yrs 40% < 21 yrs		
Managed Forest -Wet	30% >= 60 yrs 40% < 21 yrs		

Application in the Base Case:

The KBLUP-IS UWR will be used for the initial base case analysis, however a sensitivity analysis was also conducted to assess the impacts of applying the new PEM based UWR throughout the TSA.

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[10] Committee Head – Al Soobotin – WLAP Ecosystem Section Head (Nelson)

7.4.2 Identified wildlife

The following species occur within the Invermere Forest District and have been classified as "Identified Wildlife" by the Identified Wildlife Guidebook (MoF 1999).

Bull trout
Rubber boa

Fisher
Grizzly bear
Mountain goat
Bighorn sheep

American bittern
Northern goshawk
Prairie falcon
Sandhill crane
Long-billed curlew
Lewis woodpecker
Bobolink

A Wildlife Habitat Area (WHA) has been established for Lewis woodpecker in the Invermere TSA. The WHA for Lewis woodpecker is not expected to have any impacts on timber supply[11]. The impacts of future WHA's has been budgeted at a 1% AAC impact by provincial policy. This 1% was not be implemented in the model in order to allow the Chief Forester to consider this issue in his determination (refer to section 2.4.9 for more detail).

7.4.3 Caribou

Section 3 of the Kootenay Boundary Higher Level Plan Order specifies caribou habitat management guidelines to be applied in a number of zones within mapped caribou habitat. The forest cover requirements associated with these zones can be found in Table 40 and was modeled in the Base Case.

Table 40. HLPO caribou forest cover requirements

BEC/ Caribou Zone	Forest cover objectives	Area of Application	Comments
Subalpine parkland	No harvesting allowed	Crown forested area <80% slope within each habitat type by LU – less any areas of parks, protected areas, ecological reserves, or alpine forest.	Only Priority 1 and 2 mapped caribou polygons will be utilized.
ESSF above Caribou line	70% > 140yrs		
ESSF below Caribou line	40% >140 with 10% >250yrs*		
ICH above Caribou line	70% > 140 yrs		
ICH below Caribou line	40% > 140 with 10% > 250yrs		
MS	40% > 100		

* This is used as a surrogate to represent both the 30%>140 constraint and the partial cutting restrictions on an additional 20% of this zone.

New caribou guidelines based on habitat types have recently been finalized and should soon become established through an amendment to the Higher Level Plan Order. These guidelines can be found in Table 41 and was modeled in a sensitivity analysis utilizing the new caribou line work.

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[11] Personal communication; Peter Holmes – WLAP Ecosystem Biologist (Invermere), Sept 2003.

Table 41. Habitat requirements for the South Purcell caribou herd (Oct 2003)

BEC/ Habitat Zone	Forest cover objectives	Area of Application	Comments
Core – above caribou line	No harvesting allowed	Crown forested area <80% slope within each habitat type by LU – less any areas of parks, protected areas, ecological reserves, or alpine forest.	Pl/Fd/Lw leading stands have no forest cover requirements in Core, Supporting, or Recovery habitat types. No cover requirement is required in movement corridors.
Core – below caribou line within S/B/Pa/La/C/H leading stands.	No harvesting allowed		
Supporting – above caribou line	No harvesting allowed		
Supporting – below caribou line within S/B/Pa/La/C/H leading stands.	Min 70% > 60 yrs and Min 40% > 140 yrs		
Recovery – above caribou line	No harvesting allowed		
Recovery – below caribou line within S/B/Pa/La/C/H leading stands.	Min 70% > 60 yrs and Min 40% > 140 yrs		
Intra-Population Connectivity (All)	Min 33% >= 80 yrs		

7.4.4 Grizzly bear

Section 5 of the HLPO identifies important grizzly bear habitat (avalanche tracks, denning sites, etc.) as high priority areas when allocating old and mature forest retention targets (discussed in Section 7.5.1). The grizzly habitat mapping in the Invermere TSA was not in a readily useable form for the TSR process, thus no explicit recognition of these habitat features was included during the modeling of old and matures retention areas in the TSA. As this issue does not effect the amount of retention, only the spatial allocation, the impact on timber supply is considered to be minimal. Detailed planning to formally assign old and mature retention in this area will likely include consideration of grizzly bear habitat features.

7.5 Biodiversity

The *Landscape Unit Planning Guide* (LUPG), released in March 1999, consolidates policy direction and guidance on biodiversity management. The LUPG dictates that biodiversity be managed at both the landscape and stand levels. The primary mechanism for landscape-level management is retention of old and mature seral forest. Stand-level biodiversity is protected through retention of wildlife trees and wildlife patches. The following sections outline how retention of old and mature forest and wildlife trees/patches was be modeled.

7.5.1 Landscape-level biodiversity

Sections 1 and 2 of the Kootenay Boundary Higher Level Plan Order specify the amount of old and mature forest that must be maintained within each BEC variant inside each Landscape Unit (LU). Landscape units have been legally established along with Biodiversity Emphasis Option (BEO) assignments that help to guide the level of old/mature forest in LU's. Currently, the Kootenay National Park area is mapped into 3 LU's that are independent of the TSA's LU's, but they were grouped with adjacent LU's for the purpose of modeling biodiversity in this analysis (Tom Volkers, MSRM Cranbrook). [KNP1 → Shuswap/Windermere, KNP2 → Pedley, KNP3 → Cross]

Most of Invermere TSA's 34 LU's have a single BEO assigned within them, however there are five LU's that utilized BEC variant line work to define BEOs within the LU's. As new BEC variant line work is being utilized in this analysis, the BEO lines in the Higher Level Plan Order (HLPO) no longer correspond with BEC variant lines and thus create numerous small zones that are not consistent with the original HLPO logic. For the purposes of this timber supply analysis, the mapped BEO's was altered to follow the original HLPO logic (i.e., each BEC variant belongs to only one BEO per LU). This resulted in over 150 LU/BEO/BEC combinations to which landscape level biodiversity objectives could be assigned. In an effort to model seral goals that could be used operationally, zones with less than 5ha were not assigned a unique landscape level target – they were grouped into the most similar BEC variant in the LU with a common BEO.

Old forest retention was applied in all LU's as per the BEO designation shown in Table 20 and the percentage requirements outlined in Table 42. Mature forest retention was also applied as the percentages shown in Table 42, but only for the specific BEC variants and LU's described in Table 20. Specific old and mature targets by LU/BEO/BEC areas can be found in Appendix D.

Because of the new BEC mapping, the following variations from the HLPO occurred:

- The HLPO shows that ESSFwm in LU 10 is assigned an Intermediate BEO. ESSFwm no longer exists in this LU because it is included in a larger ESSF dk2 zone. The Intermediate BEO was applied to this larger area in the analysis.
- Where the HLPO species a *mature* target for ESSFdk variants, the target % was applied to both the ESSFdk1 and ESSFdk2. The area of dk1 and dk2 combined best approximated the area of the ESSFdk under the old BEC mapping.

Table 42. Old and mature forest cover requirements for landscape level biodiversity objectives

BEC Zone	**NDT**	**Mature Age (yrs)**	**Old Age (yrs)**	**MATURE + OLD Seral Requirements**			**OLD Seral Requirements**				
				Low	**Inter**	**High**	**Low* 1st Rot**	**Low* 2nd Rot**	**Low * 3rd Rot**	**Inter**	**High**
ESSF wm/wmu	1	>120	>250	19%	36%	54%	6.3%	12.6%	19%	19%	28%
ESSF dk1/dk2/dku	3	>120	>140	14%	23%	34%	4.7%	9.3%	14%	14%	21%
ICH mk1	3	>100	>140	14%	23%	34%	4.7%	9.3%	14%	14%	21%
IDF dm2/dm2n/xk	4	>100	>250	17%	34%	51%	4.3%	8.7%	13%	13%	19%
MS dk	3	>100	>140	14%	26%	39%	4.7%	9.3%	14%	14%	21%
PP dh2	4	>100	>250	17%	34%	51%	4.3%	8.7%	13%	13%	19%

* Old seral requirements in Low BEO areas start out at 1/3 old for first 80 years, 2/3 old for the next 80 years, and full old beyond.

Once the necessary amount of old/mature retention has been identified for a given LU/BEO/BEC variant combination, specific stands required to meet the target need to be identified. Section 5 of the HLPO influences this task by stating that high value grizzly habitat and areas inside the mapped connectivity corridors are to be considered high priority areas for retention. This is very challenging to model with existing tools because timber supply models are generally not able to proactively identify retention areas in each decade – they focus on cutting stands that are eligible and thus allocate retention passively. Passive retention strategies are not able to mimic the priority sequence required by section 5 of the HLPO. The solution for this timber supply analysis was to spatially identify the stands for retention prior to modeling (see Section 7.5.5 for details) and not allow the model to harvest them for the first 80 years. This ensured that all aspects of the HLPO strategy were addressed. The 80th year in the planning horizon was selected because it corresponds with the transition to higher old seral requirements in low BEO areas, and thus makes a logical point to begin to apply more general seral requirements. Full seral requirements were applied at year 160 in an attempt to ensure that the full target is met by 240 years.

7.5.1.1 Disturbance of Areas Outside the THLB

As crown forested stands in the non-THLB contribute toward several forest cover objectives (i.e., landscape level biodiversity), it is important that the age class distributions in these stands remain consistent with natural processes. By implementing disturbance in these stands, a natural age class distribution can be maintained in the model and a realistic contribution toward seral goals ensured.

A constant area was disturbed annually in each LU/NDT combination. The amount of disturbance in each LU/NDT combination was based on the BEC variants present and their associated natural disturbance intervals and old seral definitions as outlined in the *Biodiversity Guidebook* (September 1995) and Table 43.

Using the negative exponential equation, the proportion of the forest that would typically occur as old seral forest can be calculated based on the disturbance interval (% area old = exp(-[old age / interval]). Using this % area in old, the calculation of an effective rotation age associated with this seral distribution was possible (Effective rotation age = interval / (1 – proportion old)). The effective rotation age can then be used to define an annual area of disturbance. For example, ESSF variants in NDT3 have a disturbance interval of 150 yrs and an old definition of 140 yrs. This translates into a typical age class distribution where 39% of the area is "old" (>140 yrs) and the oldest stands are around 230 years. Thus 1/230th of the area needs to be disturbed each year to maintain this age class distribution.

The Base Case included:

- Annual disturbance of the contributing Non-THLB area in each LU/NDT. The selection of the stands to be disturbed was influenced by the harvest priorities in the model.
- The application of an old seral stage requirement to maintain a minimum amount of old consistent with the % old used to define the disturbance amount in Table 43.

This method is a slight simplification of Option 4 in *Modeling Options for Disturbance Outside the THLB - Working Paper* (MoF, June 2003). Modeling of disturbance at the LU/BEC variant level was simplified to the LU/NDT level in order to minimize the number of modeled zones while ensuring that each zone would have a single, old seral age.

Table 43. Calculation of area to be disturbed annually in forested non-THLB by LU/NDT

BEC *	NDT*	Disturbance Interval (yrs)	"OLD" Defn (yrs)	% Area > OLD**	Effective Rotation Age (yrs)**	Contributing Non-THLB Area (ha)	Annual Area Disturbed (ha) (area/rot age)
ESSF	3	150	140	39%	246	217,152	882
ESSF	1	300	250	49%	686	1,234	2
ICH	3	150	140	39%	246	17,756	72
IDF	4	250	250	37%	397	15,180	38
MS	3	150	140	39%	246	62,433	254
PP	4	250	250	37%	397	1,654	4
Totals						**315,409**	**1252**

* Variants within the BEC/NDT combinations shown were treated the same. ESSFwm was considered NDT1 north of Crawford Crk.

** % area old = exp (-[old age / disturbance interval]). Effective rotation age = interval / (1 – % area old)

LU	Annual Area Disturbed (ha)	LU	Annual Area Disturbed (ha)	LU	Annual Area Disturbed (ha)
I01	75	I13	22	I25	61
I02	82	I14	86	I26	38
I03	32	I15	45	I27	21
I04	28	I16	10	I28	9
I05	80	I17	9	I29	16
I06	24	I18	7	I30	20
I07	62	I19	19	I31	23
I08	22	I20	53	I32	13
I09	42	I21	21	I33	12
I10	38	I22	25	I36	27
I11	21	I23	117		
I12	48	I24	44	**Total**	**1252**

7.5.2 Stand-level biodiversity — wildlife tree retention

Wildlife tree retention is one of the primary methods to address stand level biodiversity objectives. Section 3.2 and Appendix 3 of the *Landscape Unit Planning Guide* (March 1999) detail the process for determining wildlife tree retention requirements at the subzone level in order to establish LU objectives. On May 15, 2000, the Assistant Deputy Ministers of Forests and Environment, Lands and Parks (now MSRM) approved changes to Section 3.2 of the *Landscape Unit Planning Guide*. Detailed policy on management of wildlife trees is provided in the document *Provincial Wildlife Tree Policy and Management Recommendations* (MoF/WLAP, February, 2000).

WTP retention calculations based on old BEC linework are currently being utilized for operational planning in the Invermere TSA (Licensee Planners, 2003). However, this timber supply analysis was based on the new BEC linework, thus new WTP targets were generated using the methodology outlined in the Landscape Unit Planning Guide. The resulting WTP requirements are shown in Table 44.

Occasionally, volume is retained in cutblocks at levels above that required for wildlife tree retention for a variety of forest management considerations (visuals, UWR, seed trees, etc). Where this volume is in the THLB, and there is no expectation to remove it before the start of the next rotation, it must be accounted for in the timber supply model. For purposes of this analysis, a 3.5% total yield reduction was applied to account for WTP requirements and in-block volume retention as described in Section 4.6.

For reference, the results of a GIS WTP assessment are provided in Appendix C and indicate a 1.6% THLB impact associated with future wildlife tree requirements. The results also indicates that many of the LU/BEC zones are well in excess of the WTP area requirements as a result of retention for OGMA's, MMA's, existing WTP's, riparian areas, and other forested netdowns.

Table 44. Wildlife tree retention requirements (%'s) by LU and BEC variant

Landscape Units		ESSF dk 1	ESSF dk 2	ESSF dku	ESSF wm	ICH mk 1	IDF dm 2	IDF dm 2n	IDF xk	MS dk	PP dh 2
I01	Findlay	0.3		18.5						0.6	
I02	Buhl / Bradford					4.0				2.7	
I03	Skookumchuck/Torrent	3.2				5.3	5.9			2.5	3.9
I04	Premier/Diorite						6.3			4.4	5.8
I05	Lussier/Coyote	6.5					5.2			8.0	
I06	Blackfoot/Thunder	5.2		1.5						8.0	
I07	East-Middle White	2.2								9.7	
I08	North White	7.3								8.4	
I09	Grave	2.8				3.6				8.8	
I10	Nine Mile/Moscow	1.0	1.6			8.1	8.6			6.3	
I11	Kootenay	2.7				1.8	3.0		5.5	5.0	
I12	Doctor/Fir	2.7					6.8		2.7	6.0	
I13	East Columbia	0.5					3.0		3.0	3.7	
I14	Brewer/Dutch	1.6					5.1			2.9	
I15	Toby						2.6			1.4	
I16	Jumbo		12.5		5.4					7.9	
I17	Goldie						5.1			3.5	
I18	Invermere	2.8					5.7		5.1	7.4	
I19	Fenwick	3.5				4.2				6.7	
I20	Palliser	1.3				7.9				7.1	
I21	Cochran	2.8				6.6				7.9	
I22	Albert	3.0	1.3			3.7				7.7	
I23	Cross									1.9	
I24	Pedley					4.4				5.8	
I25	Shuswap/Windermere	2.2		0.1			0.5		1.8	3.4	
I26	Horsethief	2.7	3.5				2.5			5.1	
I27	Forster		7.8			9.5	10.2			11.1	
I28	Frances		0.2			3.1				7.0	
I29	Steamboat					7.8	9.6	6.3	3.5	8.6	
I30	Kindersley/Macauley	0.1					4.5	2.6	2.3	3.1	
I31	Bugaboo		3.3	0.1		2.6				3.2	
I32	Dunbar/Templeton		0.8			6.0		5.5		6.5	
I33	Luxor	0.5				5.6	6.6			4.7	
I36	McMurdo/Fraling	0.7				2.9		1.8		0.4	

7.5.3 Coarse woody debris

Management of Coarse Woody Debris (CWD) is another important factor in the management of stand level biodiversity. As per provincial policy, it was assumed that CWD objectives are managed operationally within harvesting utilization standards.

7.5.4 Objectives for patch size distribution

Patch size management has been adopted in the TSA in an effort to more closely mimic natural disturbance patterns and minimize fragmentation of the land base. Patch size management attempts to achieve the patch size distributions specified in the Landscape Unit Planning Guide (MoF/MoE 1999), and is an alternative to cut block adjacency green-up objectives. As stated in Section 7.1, cutblock green-up requirements (adjacency) are not modeled directly in this analysis because landscape level forest cover objectives are used to approximate these requirements. As patch management is also a spatial issue beyond the resolution of this timber supply analysis, the same landscape level objectives were used to approximate patch management requirements. Detailed spatial analyses completed during previous projects have confirmed that these landscape level forest cover objectives are consistent with the flexibility associated with patch size management and the operational application of green-up requirements.

7.5.5 Objectives for connectivity

As discussed under Section 7.5.1, connectivity corridors were identified under the HLPO and are to be considered high priority when allocating old and mature forest retention areas. Spatial allocation of old and mature retention areas in the model addressed the connectivity requirements of the HLPO. The spatial delineation of old and mature seral goals was completed as per the following logic developed by MSRM Nelson (Tom Volkers):

Table 45. Logic used to select spatial OGMA and MMA areas

Priorities for Old Seral Deployment	Priorities for Mature Seral Deployment
1. Old in **Parks** (as included in specific LU's)	1. Mature or older in **Parks** (as included in specific LU's)
2. Excellent and Good MoF ranked areas in **Non-Contributing** areas	2. Mature or older **non-Pl**-leading in **Connectivity** on slopes less than 80% (or Important Grizzly Bear Habitat) in **Non-Contributing** areas
3. Old **non-Pl**-leading in **Connectivity** on slopes less than 80% (or Important Grizzly Bear Habitat) in **Non-Contributing** areas	3. Mature or older **non-Pl**-leading in **Connectivity** on slopes less than 80% (or Important Grizzly Bear Habitat) in **THLB** areas
4. Excellent and Good MoF ranked areas in **THLB** to a maximum of the hectares Identified by Tom Volkers of MSRM. (THLB impact is limited at this point)	4. Mature or older **non-Pl**-leading in **Caribou** on slopes less than 80% in **Non-Contributing** areas
5. Old **non-Pl**-leading in **Connectivity** on slopes less than 80% (or Important Grizzly Bear Habitat) in **THLB** areas	5. Mature or older **non-Pl**-leading in **Non-Contributing**
6. Old **non-Pl**-leading in **Caribou** on slopes less than 80% in **Non-Contributing** areas	6. Mature or older **non-Pl**-leading on slopes less that 80% in **Caribou** in **THLB** areas
7. Old **non-Pl**-leading in **Non-Contributing**	7. Mature or older **non-Pl** in constrained **THLB** (e.g. VQO, UWR, CWS, DWS, NDT4 Open Forest)
8. Old **non-Pl**-leading on slopes less that 80% in **Caribou** in **THLB** areas	8. Mature or older **non-Pl** in the remaining **THLB**
9. Any remaining Excellent and Good MoF ranked areas in **THLB**	9. **Mid-seral non-Pl** leading [Select oldest first, then within connectivity, regardless of whether in NC or THLB (i.e. recruitment)]
10. Old **non-Pl** in constrained **THLB** (e.g. VQO, UWR, CWS, DWS, NDT4 Open Forest)	
11. Old **non-Pl** in the remaining **THLB**	
12. Old **Pl leading** in **Non-Contributing** [Select by age class in the following order: 1) Connectivity 2) Important Grizzly Bear Habitat 3) Caribou, 4) other - all on the basis of oldest first within each category.]	
13. **Mature non-Pl** leading [Select oldest first, then within connectivity, regardless of whether in NC or THLB (i.e. recruitment)]	
14. **Mid-seral non-Pl** leading [Select oldest first, then within connectivity, regardless of whether in NC or THLB (i.e. recruitment)]	

*MoF ranking by Al Neal (2000-2003).

7.6 Watersheds

7.6.1 Community and domestic watersheds

Based on advice from the MoF Regional Hydrologist (Dave Glun, Oct 2003), community watersheds and domestic watersheds were modeled in the same manner. A forest cover requirement that approximates a 30% Equivalent Clearcut Area (ECA) was implemented (Max 30% < 6m ht) within the crown forested area of each domestic or community watershed. See Table 46 for details.

In addition, forest cover polygons containing a water intake were removed from the land base (ESA1-h) resulting in less working land base within these types of watersheds. See Table 10 for details.

Table 46. Forest cover requirements for domestic and community watersheds

Watershed Type	Forest cover objectives	Area of Application	Comments
Community Watersheds	Max 30% < 6m (22 yrs)	Crown forested area within each LU by watershed type (CWS / DWS).	22 yrs used as a surrogate for the 6m ht – based on a Fd stand with an SI of 18.3.
Domestic Watershed – Class 1	Max 30% < 6m (22 yrs)		
Domestic Watershed – Class 2	Max 30% < 6m (22 yrs)		
Domestic Watershed – Class 3	Max 30% < 6m (22 yrs)		
Domestic Watershed – Class 3s	Max 30% < 6m (22 yrs)		

7.6.2 Other Watershed Issues

The Lussier watershed has been identified by the District Manager of the Rocky Mountain Forest District as a high value watershed. As such, an ECA of 30% was applied to the CFLB area in Landscape Unit 5 (Lussier/Coyote). As discussed above, the best approximation of this in the timber supply model is a requirement that ensures no more than 30% of the forested area is under six meters in height (Max 30% < 6m).

7.7 Lakeshore management zones

In general, riparian management was predominately addressed through a netdown process that reflected both the reserve and management zones (Section 2.4.8.3). However, lakes larger than 5 ha (L1 lakes) have a 200 meter management zone that is better modeled using forest cover requirements. The 10m reserve zone on L1 lakes < 1000ha was addressed through riparian netdowns. The 200m lake Management Zone (LMZ) was managed for visual quality and assumed a maximum of 15% of the LMZ can be less than 5m at any one time. The only exceptions were L1 lakes in the NDT4, where partial harvesting practices that mimic open range and open forest are employed and no additional cover requirements are necessary.

8.0 Timber harvesting

8.1 Minimum harvestable age / merchantability standards

For this analysis, minimum harvestable ages were defined by the following economic criteria:

- minimum volume per hectare (150 m^3/ha, or 100m^3/ha for Pl on slopes <40%), and
- minimum piece size (25cm mean DBH or 20cm mean DBH for Pl on slopes < 40%), and
- the age at which 95% of the culmination of the mean annual increment (CMAI) is achieved for all other analysis units.

In order for the stand within the timber supply model to be considered for harvesting, it must achieve an age where the criteria described above are achieved. This ensures that the timber supply model is harvesting stands that meet reasonable economic criteria, and emulate what is generally current practice by forest licensees. Note that these are minimum criteria, not the actual ages at which stands are forecast for harvest. Some stands may be harvested at the minimum thresholds to meet forest-level objectives while other stands may be not be harvested until well past there "optimal" timber production ages due to management objectives for other resource values such as requirements for the retention of older forest, or ungulate winter range.

The minimum harvest age to be utilized for each analysis unit is defined in Table 47. For a detailed description of all analysis unit definitions, see Table 21.

Table 47. Minimum harvest ages

Analysis unit (AU)	AU #	Minimum harvest age (years)		Age to achieve min volume (yrs)		Age to achieve min diameter (yrs)		Age to 95% of Maximum MAI (yrs)	
		Natural	Managed	Natural	Managed	Natural	Managed	Natural	Managed
Natural Stands and Associated Future Managed Stands									
FdPy, Py	101, 201	**100**	**100**	100	100	80	80	100	100
FdOthers – Poor	103, 203	**155**	**75**	155	65	90	70	120	75
FdOthers – Mod	104, 204	**105**	**70**	105	60	80	60	105	70
FdOthers – High	105, 205	**90**	**70**	75	55	70	60	90	70
SB – Poor	106, 206	**135**	**90**	120	70	110	70	135	90
SB – Mod	107, 207	**100**	**80**	85	60	80	60	100	80
SB – High	108, 208	**80**	**70**	65	50	70	50	80	70
CH (All Sites)	109, 209	**80**	**90**	80	70	70	70	75	90
Pl Poor – slopes 0-40%	110, 210	**105**	**60**	80	40	100	40	105	60
Pl Mod – slopes 0-40%	111, 211	**80**	**60**	60	40	80	40	80	60
Pl High – slopes 0-40%	112, 212	**70**	**55**	45	35	70	40	60	55
Pl Poor – slopes >40%	114, 214	**100**	**60**	110	50	100	60	100	60
Pl Mod – slopes >40%	115, 215	**130**	**60**	75	50	130	60	80	60
Pl High – slopes >40%	116, 216	**110**	**60**	55	45	110	60	60	55
Lw – Poor	117, 217	**135**	**85**	135	70	100	70	125	85
Lw – Mod	118, 218	**115**	**85**	100	65	90	70	115	85
Lw – High	119, 219	**100**	**80**	75	60	70	60	100	80
FMER-OR	150	**110**	**N/A**	110	-	-	-	-	-
FMER-OF	151, 251	**120**	**120**	120	120	-	-	-	-
Existing Managed Stands and Associated Future Managed Stands									
FdPy, Py	501, 601	**100**	**100**	100	100	80	80	100	100
FdOthers	502, 602	**60**	**60**	50	50	60	60	60	55
SB	503, 603	**65**	**65**	55	50	60	60	65	65
CH	504, 604	**85**	**80**	70	65	70	70	85	80
Pl – Slopes 0-40%	505, 605	**60**	**60**	40	40	40	40	60	60
Pl – Slopes >40%	506, 606	**60**	**60**	50	50	60	60	60	60
Lw	507, 607	**70**	**70**	60	60	60	60	70	70

Note: Existing managed stands harvest ages (500 series) are generally lower than future managed stands (200 series) because of species differences (often Pl leading even though in other inventory type groups).

8.2 Harvest systems

Harvesting in the Invermere TSA is dominated by ground based harvest systems, with a small amount of cable systems used. Cable systems are used on steeper slopes, where ground based methods become impractical. Stands eligible for cable harvesting are distinguished by slopes greater than 50% - a 40% slope break has been used in the analysis in recognition that ground based systems have higher costs when working on steeper slopes. Cable harvest stands have higher site index thresholds for low site stands, and have longer rotations for pine stands, to allow more time for trees to attain a merchantable size.

The table below summarizes the breakdown of harvest systems within the TSA.

Table 48. Harvest methods

Harvest method	Historic harvest contribution (TSR2 %)	THLB Area (ha)
Ground-based (e.g., skidder)	91.2%	165,520 (70.8%)
Cable	8.6%	66,666 (28.6%)
Helicopter	0.2%	1,487 (0.6%)
Totals	100.0%	233,673 (100%)

8.3 Initial harvest rate

The base case harvest forecast used the following initial harvest rates in the forecast:

Initial Harvest: 581,570 $^{m^3}$/yr (current AAC) + Unsalvaged losses (24,327 $^{m^3}$/yr) = 605,897 $^{m^3}$/yr

8.4 Harvest Priorities and Rules

Harvest rules which have the goal of achieving a mean harvest age that resembles current management were used in this analysis. With numerous pressures from bark beetle infestations and fires, forest licensees are not always necessarily harvesting the oldest stands available for harvest first. A summary of historical harvest data and Forest Development Plan data was used to determine actual mean harvest ages. The overall goal for the TSR3 analysis was to achieve a short term mean harvest age that is within 10 years of the actual mean age. The harvest priorities in the table below were utilized in the timber supply model to achieve these mean ages.

Table 49. Harvest priority rules

Harvest priority	Description
1. Fire salvage	Harvest was capped to reflect likely salvage volumes. At the end of the first period, any fire salvage stands not harvested in the model, was reset to age 0 on a natural stand yield table.
2. Susceptible Beetle Stands	Mature lodgepole pine leading stands.
3. OF/ OR restoration	Open range and Open Forest stands within the Timber Harvesting Land base (up to maximum 1/27th of identified restoration area per year – attempting to treat all these stands by 2030[12])
4. Oldest first.	The oldest stands available in the THLB after ensuring all forest cover requirements are met.

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[12] As per "A Blueprint for Action", Rocky Mountain Trench Ecosystem Restoration Steering Committee, February 2000

8.5 Timber supply model

The following timber supply model was used for this analysis:

Name: Forest Service Simulator (FSSIM) version 3.2

Type: Simulation Model

Description: FSSIM, is developed and maintained by the Ministry of Forests Forest Analysis Branch. FSSIM has been used continuously in the province for many years. It is a well-documented and well-understood model that is designed to work well with BC's forestry policy and practices FSSIM is a spatially-implicit model that allows for the modeling of constraints and harvesting with the ability to group and define forest units (classes) with geographic or biological similarities. FSSIM can be as detailed or as generalized as desired, to meet the needs of the modeling requirements. FSSIM is a simulation model, thus permitting the exploration of how individual factors effect harvest flow as well as allowing for complete control over these factors – providing results that are realistic, tangible, and repeatable.

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Appendix C - Wildlife Tree Retention Calculations

Existing mapped wildlife trees was removed from the land base through netdowns. The areas of mature forested netdowns (riparian, low sites, unstable areas, OGMAs, etc) were assumed to contribute toward WTP requirements. Additional areas of WTP retention required within each LU/BEC variant combination was determined using the following methodology:

(FOR REFERENCE ONLY - NOT USED IN BASE CASE)

1. The crown forested areas excluded from timber harvesting (including OGMAs/MMAs) over 80 years old were buffered by 250 m. This identified areas within the THLB that did not meet the 500m spacing rule for wildlife tree retention. Any additional area of WTP's required to meet spacing requirements was calculated for each LU/BEC variant as: ha requiring WTPs x WTPtarget %.
2. The total area of forested reserve + additional WTP was then compared to the required target area. For the LU's shown to be in deficit, the additional area required was calculated.
3. For each LU/BEC variant, the total additional WTP requirement (steps 2 and 3) was calculated as a percent of the THLB area. These values were then rolled up to the TSA level by calculating an average additional WTP requirement (weighted by THLB area of each LU/BEC variant) for the THLB.

The result indicated that 1.6% of the THLB was required to meet future WTP requirements.

LU	LU_NAME	BECLABEL	NDT	CFLB (ha)	THLB (ha)	% Logged no WTP	% Available for Harvest	Gross WTP %	WTP Required HA	CFLB Forest Netdown HA	THLB outside 250m buffer (ha)	Addnl WTP Required for Spacing (ha)	WTP Deficit (ha)	Total Additional WTP Required (ha)	% Additional WTP Required
I13	East Columbia	MS dk	3	4,522	2,367	11	52	3.4	151.6	2,155.3	335.1	11.2	0.0	11.2	0.5
I14	Brewer - Dutch	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I14	Brewer - Dutch	ESSFdk 1	3	16,419	4,581	17	28	1.5	247.1	11,837.2	1,757.1	26.4	0.0	26.4	0.6
I14	Brewer - Dutch	ESSFdku	3	4,813	261	7	5	0.0	0.0	4,552.3	45.5	0.0	0.0	0.0	0.0
I14	Brewer - Dutch	IDF dm 2	4	2,368	1,787	4	75	4.9	117.1	580.7	377.6	18.7	0.0	18.7	1.0
I14	Brewer - Dutch	IDF xk	4	28	0	0	0	0.0	0.0	28.0	0.0	0.0	0.0	0.0	0.0
I14	Brewer - Dutch	MS dk	3	8,816	4,718	5	54	2.9	254.0	4,098.1	1,152.3	33.2	0.0	33.2	0.7
I15	Toby	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I15	Toby	ESSFdk 1	3	7,184	739	3	10	0.0	0.0	6,445.4	219.0	0.0	0.0	0.0	0.0
I15	Toby	ESSFdku	3	1,171	14	0	1	0.0	0.0	1,156.7	0.0	0.0	0.0	0.0	0.0
I15	Toby	IDF dm 2	4	210	118	0	56	2.6	5.5	91.8	17.2	0.5	0.0	0.5	0.4
I15	Toby	MS dk	3	5,512	2,098	5	38	1.3	73.9	3,413.9	454.2	6.1	0.0	6.1	0.3
I16	Jumbo	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I16	Jumbo	ESSFdk 1	3	56	17	0	30	0.0	0.0	39.5	0.0	0.0	0.0	0.0	0.0
I16	Jumbo	ESSFdk 2	3	1,418	95	48	7	2.5	35.3	1,322.9	8.4	0.2	0.0	0.2	0.2
I16	Jumbo	ESSFdku	3	128	0	0	0	0.0	0.0	128.4	0.0	0.0	0.0	0.0	0.0
I16	Jumbo	ESSFwm	1	1,722	758	31	44	4.5	77.7	964.6	51.2	2.3	0.0	2.3	0.3
I16	Jumbo	ESSFwmu	1	291	22	0	7	0.0	0.0	269.4	0.0	0.0	0.0	0.0	0.0
I16	Jumbo	MS dk	3	864	431	41	50	6.1	52.4	433.4	61.2	3.7	0.0	3.7	0.9
I17	Goldie	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I17	Goldie	ESSFdk 1	3	1,373	130	0	9	0.0	0.0	1,242.7	11.0	0.0	0.0	0.0	0.0
I17	Goldie	ESSFdku	3	194	0	0	0	0.0	0.0	194.3	0.0	0.0	0.0	0.0	0.0
I17	Goldie	IDF dm 2	4	618	413	13	67	5.0	30.8	205.1	89.8	4.5	0.0	4.5	1.1
I17	Goldie	MS dk	3	1,077	567	12	53	3.5	37.2	509.7	8.0	0.3	0.0	0.3	0.0
I18	Invermere	ESSFdk 1	3	1,267	572	12	45	2.7	34.4	695.0	82.4	2.2	0.0	2.2	0.4
I18	Invermere	ESSFdku	3	80	0	0	0	0.0	0.0	80.0	0.0	0.0	0.0	0.0	0.0
I18	Invermere	IDF dm 2	4	1,776	1,245	11	70	5.2	91.6	530.6	426.1	22.0	0.0	22.0	1.8
I18	Invermere	IDF xk	4	587	465	1	79	5.0	29.5	121.6	162.7	8.2	0.0	8.2	1.8
I18	Invermere	MS dk	3	2,361	1,975	19	84	7.3	171.8	385.2	629.5	45.8	0.0	45.8	2.3
I19	Fenwick	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I19	Fenwick	ESSFdk 1	3	4,013	1,716	18	43	3.1	122.5	2,295.5	207.4	6.3	0.0	6.3	0.4
I19	Fenwick	ESSFdku	3	727	38	10	5	0.0	0.0	688.8	3.4	0.0	0.0	0.0	0.0
I19	Fenwick	ICH mk 1	3	2,4[illegible]	1,541	8	63	4.1	100.8	901.1	367.4	15.2	0.0	15.2	1.0
I19	Fenwick	MS dk	3	6,036	5,399	7	89	6.7	403.6	636.8	708.5	47.4	0.0	47.4	0.9
I20	Palliser	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I20	Palliser	ESSFdk 1	3	8,882	1,351	26	15	1.1	99.8	7,530.8	139.4	1.6	0.0	1.6	0.1
I20	Palliser	ESSFdku	3	2,918	0	0	0	0.0	0.0	2,918.5	0.0	0.0	0.0	0.0	0.0
I20	Palliser	ICH mk 1	3	1,094	873	27	80	7.7	84.4	220.9	181.4	14.0	0.0	14.0	1.6
I20	Palliser	MS dk	3	5,732	3,321	39	58	6.7	386.0	2,410.5	588.8	39.7	0.0	39.7	1.2
I21	Cochran	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I21	Cochran	ESSFdk 1	3	3,500	1,208	21	35	2.5	89.1	2,292.7	196.0	5.0	0.0	5.0	0.4
I21	Cochran	ESSFdku	3	659	0	0	0	0.0	0.0	659.3	0.0	0.0	0.0	0.0	0.0
I21	Cochran	ICH mk 1	3	1,679	1,111	27	66	6.3	105.5	567.9	208.8	13.1	0.0	13.1	1.2
I21	Cochran	MS dk	3	8,954	7,170	27	80	7.7	692.3	1,784.4	2,427.8	187.7	0.0	187.7	2.6
I22	Albert	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I22	Albert	ESSFdk 1	3	33	18	4	56	3.0	1.0	14.3	0.0	0.0	0.0	0.0	0.0
I22	Albert	ESSFdk 2	3	4,302	1,107	14	26	0.9	40.7	3,195.1	91.3	0.9	0.0	0.9	0.1
I22	Albert	ESSFdku	3	1,738	186	0	11	0.0	0.0	1,552.5	0.0	0.0	0.0	0.0	0.0
I22	Albert	ICH mk 1	3	2,349	1,170	12	50	3.2	75.3	1,178.3	62.1	2.0	0.0	2.0	0.2
I22	Albert	MS dk	3	1,206	891	31	74	7.5	90.4	315.0	73.3	5.5	0.0	5.5	0.6
I23	Cross	AT un	5	245	0	0	0	0.0	0.0	244.8	0.0	0.0	0.0	0.0	0.0
I23	Cross	ESSFdk 1	3	19,027	2,204	10	12	0.0	0.0	16,823.6	133.2	0.0	0.0	0.0	0.0
I23	Cross	ESSFdku	3	5,819	0	0	0	0.0	0.0	5,818.5	0.0	0.0	0.0	0.0	0.0
I23	Cross	MS dk	3	9,727	3,514	11	36	1.8	170.9	6,212.9	1,022.2	18.0	0.0	18.0	0.5
I24	Pedley	AT un	5	117	0	0	0	0.0	0.0	116.6	0.0	0.0	0.0	0.0	0.0
I24	Pedley	ESSFdk 1	3	5,898	716	6	12	0.0	0.0	5,182.3	80.8	0.0	0.0	0.0	0.0
I24	Pedley	ESSFdku	3	1,045	10	0	1	0.0	0.0	1,035.6	0.0	0.0	0.0	0.0	0.0
I24	Pedley	ICH mk 1	3	4,698	2,800	13	60	4.2	198.1	1,898.3	585.7	24.7	0.0	24.7	0.9
I24	Pedley	MS dk	3	7,786	4,964	23	64	5.7	440.1	2,822.2	630.9	35.7	0.0	35.7	0.7
I25	Shuswap - Windermere	AT un	5	309	0	0	0	0.0	0.0	308.6	0.0	0.0	0.0	0.0	0.0
I25	Shuswap - Windermere	ESSFdk 1	3	9,173	685	26	7	0.4	34.5	8,488.7	39.6	0.1	0.0	0.1	0.0
I25	Shuswap - Windermere	ESSFdku	3	955	14	0	2	0.0	0.0	9[illegible]0.9	0.0	0.0	0.0	0.0	0.0
I25	Shuswap - Windermere	IDF dm 2	4	1,525	272	6	18	0.0	0.0	1,253.1	35.5	0.0	0.0	0.0	0.0
I25	Shuswap - Windermere	IDF xk	4	355	171	0	48	1.8	6.5	183.6	38.3	0.7	0.0	0.7	0.4
I25	Shuswap - Windermere	MS dk	3	6,755	2,[illegible]38	27	32	2.8	191.9	4,616.6	360.3	10.2	0.0	10.2	0.5
I26	Horsethief	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I26	Horsethief	ESSFdk 1	3	4,533	1,092	31	24	2.5	111.7	3,440.8	174.5	4.3	0.0	4.3	0.4
I26	Horsethief	ESSFdk 2	3	3,010	377	31	13	1.3	39.9	2,633.2	70.1	0.9	0.0	0.9	0.2
I26	Horsethief	ESSFdku	3	1,223	7	0	1	0.0	0.0	1,216.4	0.0	0.0	0.0	0.0	0.0
I26	Horsethief	IDF dm 2	4	176	95	1	54	2.5	4.4	81.2	13.3	0.3	0.0	0.3	0.4
I26	Horsethief	MS dk	3	4,760	2,744	17	58	4.5	212.9	2,015.2	537.5	24.0	0.0	24.0	0.9
I27	Forster	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I27	Forster	ESSFdk 1	3	5	0	0	0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0

LU	LU_NAME	BECLABEL	NDT	CFLB (ha)	THLB (ha)	% Logged no WTP	% Available for Harvest	Gross WTP %	WTP Required HA	CFLB Forest Netdown HA	THLB outside 250m buffer (ha)	Addnl WTP Required for Spacing (ha)	WTP Deficit (ha)	Total Additional WTP Required (ha)	% Additional WTP Required
127	Forster	ESSFdk 2	3	4,228	419	12	10	0.0	0.0	3,809.2	5.3	0.0	0.0	0.0	0.0
127	Forster	ESSFdku	3	456	0	0	0	0.0	0.0	455.9	0.0	0.0	0.0	0.0	0.0
127	Forster	ICH mk 1	3	658	99	25	15	1.0	6.4	558.9	16.9	0.2	0.0	0.2	0.2
127	Forster	IDF dm 2	4	52	25	3	48	2.1	1.1	26.7	7.1	0.1	0.0	0.1	0.6
127	Forster	MS dk	3	697	105	54	15	3.9	27.3	592.2	9.3	0.4	0.0	0.4	0.3
128	Frances	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
128	Frances	ESSFdk 2	3	2,019	218	12	11	0.0	0.0	1,801.8	5.1	0.0	0.0	0.0	0.0
128	Frances	ESSFdku	3	237	0	0	0	0.0	0.0	237.4	0.0	0.0	0.0	0.0	0.0
128	Frances	ICH mk 1	3	760	424	4	56	3.0	22.5	335.6	19.7	0.6	0.0	0.6	0.1
128	Frances	MS dk	3	5	5	0	100	7.0	0.3	0.0	4.8	0.3	0.3	0.7	13.8
129	Steamboat	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
129	Steamboat	ESSFdk 1	3	129	0	0	0	0.0	0.0	129.4	0.0	0.0	0.0	0.0	0.0
129	Steamboat	ESSFdk 2	3	863	37	8	4	0.0	0.0	826.2	2.6	0.0	0.0	0.0	0.0
129	Steamboat	ESSFdku	3	18	0	0	0	0.0	0.0	18.1	0.0	0.0	0.0	0.0	0.0
129	Steamboat	ICH mk 1	3	2,476	2,060	24	83	7.7	191.5	416.0	403.6	31.2	0.0	31.2	1.5
129	Steamboat	IDF dm 2	4	11,187	9,731	34	87	9.1	1,017.5	1,456.1	2,679.3	243.7	0.0	243.7	2.5
129	Steamboat	IDF dm 2n	4	418	323	15	77	6.2	25.9	94.9	73.4	4.6	0.0	4.6	1.4
129	Steamboat	IDF xk	4	304	191	2	63	3.4	10.5	112.9	46.9	1.6	0.0	1.6	0.8
129	Steamboat	MS dk	3	6,146	4,640	35	75	8.1	495.0	1,505.9	2,171.1	174.9	0.0	174.9	3.8
130	Kindersley - Macauley	ESSFdk 1	3	2,579	255	13	10	0.0	0.0	2,323.6	15.2	0.0	0.0	0.0	0.0
130	Kindersley - Macauley	ESSFdku	3	170	0	0	0	0.0	0.0	170.4	0.0	0.0	0.0	0.0	0.0
130	Kindersley - Macauley	IDF dm 2	4	910	617	3	68	4.1	37.4	292.5	48.9	2.0	0.0	2.0	0.3
130	Kindersley - Macauley	IDF dm 2n	4	246	138	0	56	2.6	6.5	107.9	3.9	0.1	0.0	0.1	0.1
130	Kindersley - Macauley	IDF xk	4	10	5	0	53	2.3	0.2	4.8	0.0	0.0	0.0	0.0	0.0
130	Kindersley - Macauley	MS dk	3	4,012	1,689	13	42	2.5	101.8	2,323.0	272.2	6.9	0.0	6.9	0.4
131	Bugaboo	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
131	Bugaboo	ESSFdk 2	3	5,335	2,271	17	43	2.9	156.7	3,064.2	215.1	6.3	0.0	6.3	0.3
131	Bugaboo	ESSFdku	3	2,031	95	23	5	0.0	0.0	1,935.4	1.0	0.0	0.0	0.0	0.0
131	Bugaboo	ICH mk 1	3	1,137	634	0	56	2.6	29.3	502.9	31.2	0.8	0.0	0.8	0.1
131	Bugaboo	MS dk	3	517	301	3	58	3.2	16.3	216.0	7.5	0.2	0.0	0.2	0.1
132	Dunbar - Templeton	AT un	5	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
132	Dunbar - Templeton	ESSFdk 2	3	1,432	508	2	35	0.8	11.1	924.0	62.3	0.5	0.0	0.5	0.1
132	Dunbar - Templeton	ESSFdku	3	311	0	0	0	0.0	0.0	310.5	0.0	0.0	0.0	0.0	0.0
132	Dunbar - Templeton	ICH mk 1	3	2,323	1,939	7	83	6.0	139.7	384.0	187.3	11.3	0.0	11.3	0.6
132	Dunbar - Templeton	IDF dm 2n	4	1,863	1,487	5	80	5.5	102.3	376.3	235.1	12.9	0.0	12.9	0.9
132	Dunbar - Templeton	MS dk	3	7,446	6,227	10	84	6.4	474.6	1,218.1	831.2	53.0	0.0	53.0	0.9
133	Luxor	ESSFdk 1	3	2,516	557	9	22	0.1	2.8	1,963.7	8.8	0.0	0.0	0.0	0.0
133	Luxor	ESSFdku	3	125	3	0	3	0.0	0.0	121.7	0.0	0.0	0.0	0.0	0.0
133	Luxor	ICH mk 1	3	823	541	15	66	5.1	42.0	281.5	18.7	1.0	0.0	1.0	0.2
133	Luxor	IDF dm 2	4	424	271	25	64	5.9	25.2	152.5	59.0	3.5	0.0	3.5	1.3
133	Luxor	MS dk	3	2,159	1,414	10	65	4.5	98.2	745.1	198.1	9.0	0.0	9.0	0.6
136	McMurdo - Fraling	ESSFdk 1	3	3,206	130	0	4	0.0	0.0	3,075.9	0.0	0.0	0.0	0.0	0.0
136	McMurdo - Fraling	ESSFdku	3	41	0	0	0	0.0	0.0	41.4	0.0	0.0	0.0	0.0	0.0
136	McMurdo - Fraling	ICH mk 1	3	5,987	2,834	9	47	2.7	159.1	3,153.0	457.3	12.2	0.0	12.2	0.4
136	McMurdo - Fraling	IDF dm 2n	4	707	290	1	41	1.2	8.4	417.3	52.1	0.6	0.0	0.6	0.2
136	McMurdo - Fraling	MS dk	3	72	24	0	34	0.4	0.3	47.6	0.0	0.0	0.0	0.0	0.0
Totals				554,646	238,270				18,873.6	316,378.1	68,094.7	3,846.1	0.3	3,846.5	Wtd Avg
															1.6%

Appendix D – Old and Mature Biodiversity Targets

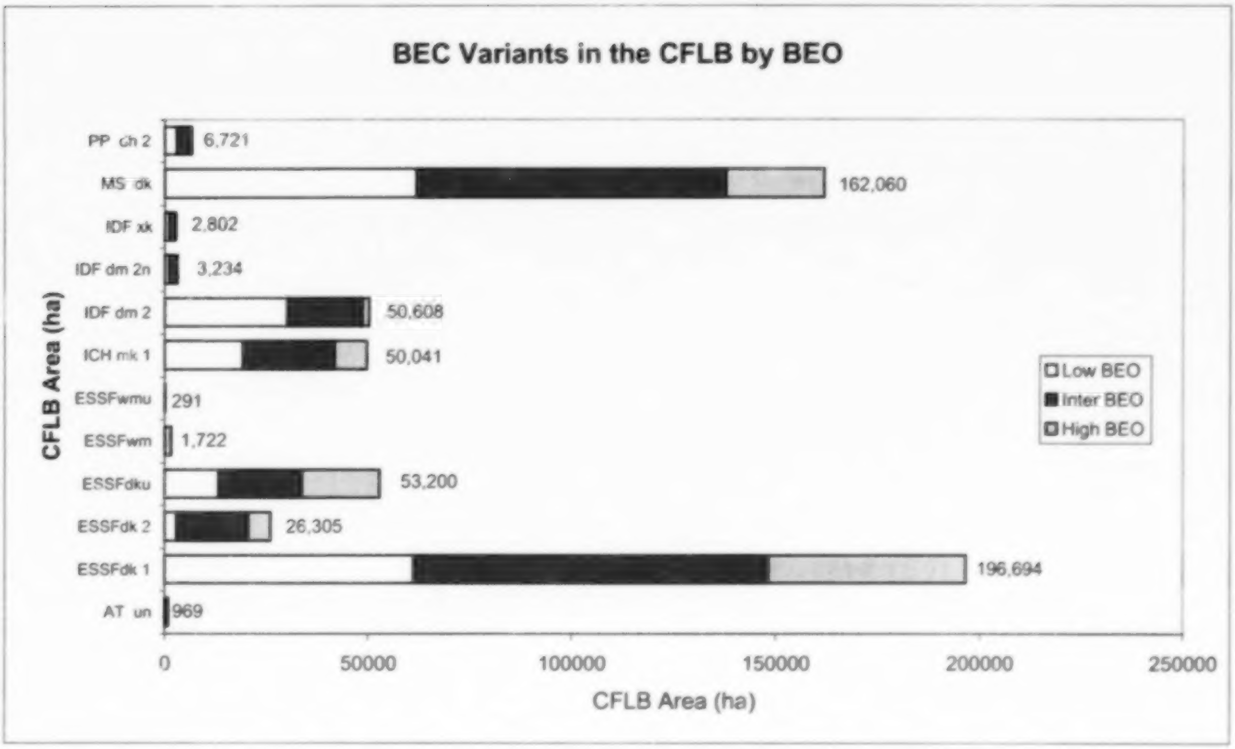
Invermere TSA: Landscape Unit Area Summary by BEC Variant

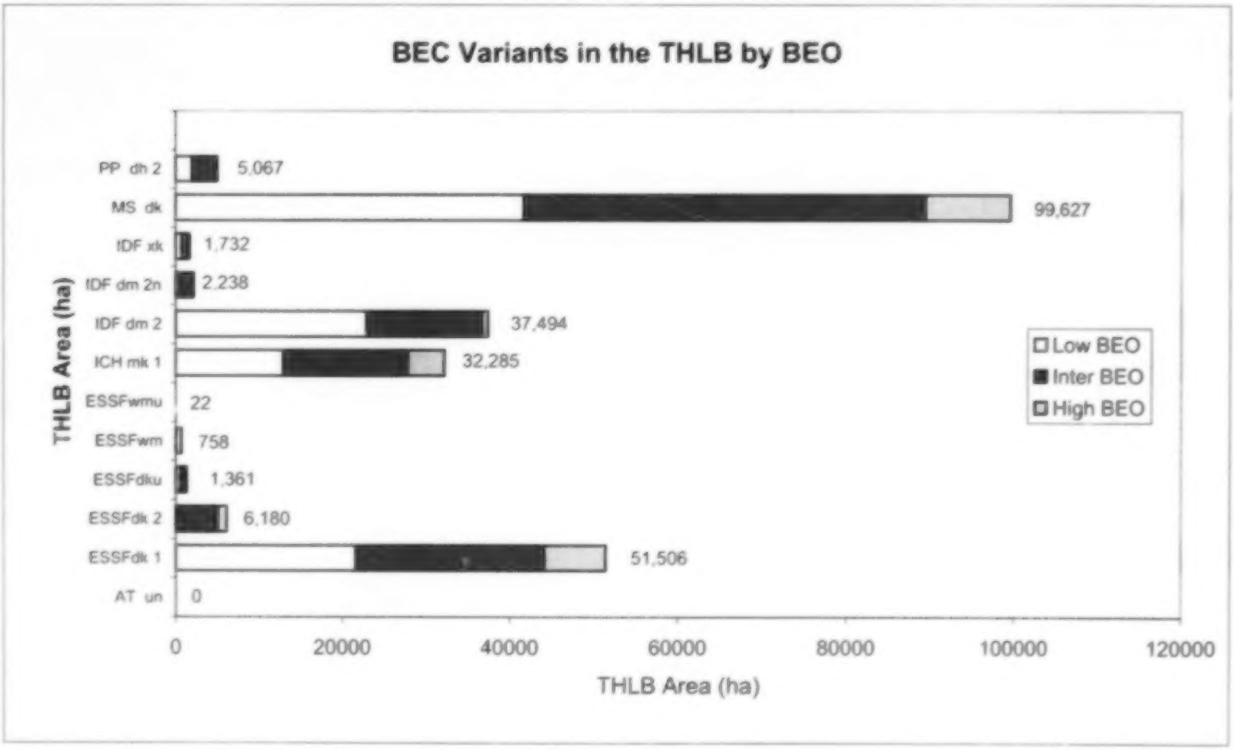
								Old Seral Goals			Old + Mature Seral Goals		
LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
I01	Findlay	H	AT un	5	-	289	7,781	-	-	-	-	-	-
I01	Findlay	H	ESSFdk 1	3	1,005	11,170	18,792	21.0	2,346	2,432	34.0	3,798	3,799
I01	Findlay	H	ESSFdku	3	4	4,199	20,036	21.0	882	890	-	-	-
I01	Findlay	H	IDF dm 2	4	-	-	241	-	-	-	-	-	-
I01	Findlay	H	MS dk	3	1,294	5,397	6,933	21.0	1,133	1,134	-	-	-
Findlay Total					2,303	21,055	53,782		4,361	4,456		3,798	3,799
I02	Buhl - Bradford	H	AT un	5	-	-	2,076	-	-	-	-	-	-
I02	Buhl - Bradford	H	ESSFdk 1	3	2,453	13,598	18,261	21.0	2,856	2,856	34.0	4,623	4,627
I02	Buhl - Bradford	H	ESSFdku	3	89	7,216	22,331	21.0	1,515	1,520	-	-	-
I02	Buhl - Bradford	H	ICH mk 1	3	2,168	3,239	3,569	21.0	680	681	-	-	-
I02	Buhl - Bradford	H	MS dk	3	1,172	2,346	2,887	21.0	493	493	39.0	915	916
Buhl - Bradford Total					5,883	26,399	49,124		5,544	5,550		5,538	5,543
I03	Skookumchuck - Torrent	L	ESSFdk 1	3	1,656	4,375	5,541	4.7	206	206	-	-	-
I03	Skookumchuck - Torrent	L	ESSFdku	3	-	495	1,549	4.7	23	49	-	-	-
I03	Skookumchuck - Torrent	L	ICH mk 1	3	6,295	8,290	9,263	4.7	390	394	-	-	-
I03	Skookumchuck - Torrent	L	IDF dm 2	4	4,659	6,149	9,568	4.3	264	267	-	-	-
I03	Skookumchuck - Torrent	L	MS dk	3	1,374	3,018	3,614	4.7	143	145	-	-	-
I03	Skookumchuck - Torrent	L	PP dh 2	4	1,739	2,862	5,960	4.3	123	141	-	-	-
Skookumchuck - Torrent Total					15,723	25,220	35,495		1,149	1,202		-	-
I04	Premier - Diorite	I	PP dh 2	4	2,746	3,859	6,443	13.0	502	503	-	-	-
I04	Premier - Diorite	L	AT un	5	-	-	156	-	-	-	-	-	-
I04	Premier - Diorite	L	ESSFdk 1	3	220	2,463	3,831	4.7	116	125	-	-	-
I04	Premier - Diorite	L	ESSFdku	3	-	597	4,203	4.7	28	34	-	-	-
I04	Premier - Diorite	L	IDF dm 2	4	7,839	11,175	23,310	4.3	481	484	-	-	-
I04	Premier - Diorite	L	IDF xk	4	-	11	136	-	-	-	-	-	-
I04	Premier - Diorite	L	MS dk	3	2,825	4,511	5,162	4.7	212	216	-	-	-
Premier - Diorite Total					13,630	22,616	43,242		1,339	1,339		-	-
I05	Lussier - Coyote	L	AT un	5	-	10	1,729	-	-	-	-	-	-
I05	Lussier - Coyote	L	ESSFdk 1	3	7,333	18,868	23,582	4.7	887	910	-	-	-
I05	Lussier - Coyote	L	ESSFdku	3	297	4,302	13,399	4.7	202	221	-	-	-
I05	Lussier - Coyote	L	IDF dm 2	4	1,253	1,785	2,770	4.3	77	77	-	-	-
I05	Lussier - Coyote	L	MS dk	3	8,473	12,503	13,985	4.7	588	589	-	-	-
Lussier - Coyote Total					17,356	37,468	55,465		1,754	1,797		-	-
I06	Blackfoot - Thunder	L	AT un	5	-	-	3,891	-	-	-	-	-	-
I06	Blackfoot - Thunder	L	ESSFdk 1	3	3,997	7,411	9,734	4.7	348	349	-	-	-
I06	Blackfoot - Thunder	L	ESSFdku	3	138	1,261	7,174	4.7	59	59	-	-	-
I06	Blackfoot - Thunder	L	MS dk	3	2,199	3,309	3,617	4.7	156	157	-	-	-
Blackfoot - Thunder Total					6,334	11,981	24,417		563	565		-	-
I07	East-Middle White	I	AT un	5	-	-	4,734	-	-	-	-	-	-
I07	East-Middle White	I	ESSFdk 1	3	4,496	15,830	20,255	14.0	2,216	2,217	-	-	-
I07	East-Middle White	I	ESSFdku	3	27	2,893	13,324	14.0	405	408	-	-	-
I07	East-Middle White	I	MS dk	3	3,032	4,064	4,401	14.0	569	582	-	-	-
East-Middle White Total					7,555	22,787	42,714		3,190	3,207		-	-
I08	North White	I	AT un	5	-	-	3,233	-	-	-	-	-	-
I08	North White	I	ESSFdk 1	3	6,351	9,948	12,714	14.0	1,393	1,393	-	-	-
I08	North White	I	ESSFdku	3	98	1,789	8,495	14.0	250	254	-	-	-
I08	North White	I	MS dk	3	1,776	2,136	2,338	14.0	299	299	-	-	-
North White Total					8,225	13,872	26,780		1,942	1,946		-	-
I09	Grave	I	AT un	5	-	-	1,375	-	-	-	-	-	-
I09	Grave	I	ICH mk 1	3	1,730	3,238	3,482	14.0	453	453	-	-	-
I09	Grave	L	AT un	5	-	-	53	-	-	-	-	-	-
I09	Grave	L	ESSFdk 1	3	2,709	7,524	10,200	4.7	354	354	-	-	-
I09	Grave	L	ESSFdku	3	18	1,294	6,355	4.7	61	61	-	-	-
I09	Grave	L	MS dk	3	6,811	9,547	10,828	4.7	449	453	-	-	-
Grave Total					11,268	21,603	32,292		1,317	1,321		-	-
I10	Nine Mile - Moscow	I	ESSFdk 2	3	1,134	3,698	5,274	14.0	518	527	-	-	-
I10	Nine Mile - Moscow	I	ICH mk 1	3	4,699	6,361	6,922	14.0	890	891	-	-	-
I10	Nine Mile - Moscow	L	AT un	5	-	-	119	-	-	-	-	-	-
I10	Nine Mile - Moscow	L	ESSFdk 1	3	567	2,209	3,482	4.7	104	104	-	-	-
I10	Nine Mile - Moscow	L	ESSFdku	3	14	785	5,046	4.7	37	49	-	-	-
I10	Nine Mile - Moscow	L	IDF dm 2	4	2,764	3,302	4,309	4.3	142	142	-	-	-
I10	Nine Mile - Moscow	L	MS dk	3	6,108	8,626	9,801	4.7	405	407	-	-	-
Nine Mile - Moscow Total					15,287	24,981	34,953		2,096	2,120		-	-
I11	Kootenay	H	AT un	5	-	-	5	-	-	-	-	-	-
I11	Kootenay	H	ESSFdk 1	3	1,202	3,327	5,846	21.0	699	701	34.0	1,131	1,133
I11	Kootenay	H	ESSFdku	3	-	58	1,179	21.0	12	15	-	-	-
I11	Kootenay	H	ICH mk 1	3	1,165	2,487	2,959	21.0	522	523	-	-	-
I11	Kootenay	H	IDF dm 2	4	454	1,147	1,534	19.0	218	218	-	-	-
I11	Kootenay	H	IDF xk	4	68	98	937	19.0	19	19	-	-	-
I11	Kootenay	H	MS dk	3	2,392	3,519	4,289	21.0	739	739	39.0	1,373	1,375
Kootenay Total					5,282	10,637	16,750		2,209	2,215		2,504	2,508
I12	Doctor - Fir	L	AT un	5	-	-	1,800	-	-	-	-	-	-
I12	Doctor - Fir	L	ESSFdk 1	3	2,642	7,831	9,551	4.7	368	369	-	-	-
I12	Doctor - Fir	L	ESSFdku	3	33	3,322	7,613	4.7	156	157	-	-	-
I12	Doctor - Fir	L	IDF dm 2	4	3,676	5,206	11,663	4.3	224	227	-	-	-
I12	Doctor - Fir	L	IDF xk	4	197	384	5,086	4.3	17	19	-	-	-
I12	Doctor - Fir	L	MS dk	3	5,320	7,892	10,178	4.7	371	371	-	-	-
Doctor - Fir Total					11,868	24,634	45,891		1,136	1,143		-	-
I13	East Columbia	I	AT un	5	-	-	123	-	-	-	-	-	-
I13	East Columbia	I	ESSFdk 1	3	348	2,347	3,952	14.0	329	330	-	-	-
I13	East Columbia	I	ESSFdku	3	-	127	1,429	14.0	18	24	-	-	-
I13	East Columbia	I	IDF dm 2	4	1,280	2,598	3,573	13.0	338	341	-	-	-
I13	East Columbia	I	IDF xk	4	569	1,026	6,075	13.0	133	137	-	-	-
I13	East Columbia	I	MS dk	3	2,329	4,522	5,259	14.0	633	644	-	-	-
East Columbia Total					4,526	10,621	20,410		1,451	1,476		-	-
I14	Brewer - Dutch	I	AT un	5	-	-	6,253	-	-	-	-	-	-
I14	Brewer - Dutch	I	ESSFdk 1	3	3,997	16,419	22,776	14.0	2,299	2,306	-	-	-
I14	Brewer - Dutch	I	ESSFdku	3	168	4,813	22,638	14.0	674	674	-	-	-
I14	Brewer - Dutch	I	IDF dm 2	4	1,615	2,368	4,546	13.0	311	313	-	-	-
I14	Brewer - Dutch	I	IDF xk	4	-	28	139	-	-	-	-	-	-
I14	Brewer - Dutch	I	MS dk	3	4,158	8,816	11,021	14.0	1,234	1,237	-	-	-
Brewer - Dutch Total					9,937	32,443	67,374		4,518	4,530		-	-

LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	Old Seral Goals			Old + Mature Seral Goals		
								%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
I15	Toby	I	AT un	5	-	-	7,665	-	-	-	-	-	-
I15	Toby	I	ESSFdk 1	3	660	7,184	15,376	14.0	1,006	1,007	-	-	-
I15	Toby	I	ESSFdku	3	14	1,171	13,491	14.0	164	165	-	-	-
I15	Toby	I	IDF dm 2	4	119	210	286	13.0	27	28	-	-	-
I15	Toby	I	MS dk	3	2,093	5,512	8,437	14.0	772	773	-	-	-
Toby Total					2,886	14,078	45,254		1,969	1,973		-	-
I16	Jumbo	H	AT un	5	-	-	4,507	-	-	-	-	-	-
I16	Jumbo	H	ESSFdk 1	3	17	56	68	21.0	12	13	34.0	19	14
I16	Jumbo	H	ESSFdk 2	3	95	1,418	2,541	21.0	298	299	34.0	482	490
I16	Jumbo	H	ESSFdku	3	-	128	2,012	21.0	27	31	-	-	-
I16	Jumbo	H	ESSFwm	1	756	1,722	2,499	28.0	482	482	24.0	413	415
I16	Jumbo	H	ESSFwmu	1	22	291	1,820	28.0	81	82	-	-	-
I16	Jumbo	H	MS dk	3	431	864	1,091	21.0	181	182	39.0	337	272
Jumbo Total					1,322	4,480	14,539		1,081	1,089		1,251	1,191
I17	Goldie	H	AT un	5	-	-	87	-	-	-	-	-	-
I17	Goldie	H	ESSFdk 1	3	142	1,373	2,129	21.0	288	289	34.0	467	473
I17	Goldie	H	ESSFdku	3	-	194	1,506	21.0	41	45	-	-	-
I17	Goldie	H	IDF dm 2	4	413	618	2,529	19.0	117	121	-	-	-
I17	Goldie	H	MS dk	3	567	1,077	1,395	21.0	226	227	39.0	420	427
Goldie Total					1,122	3,262	7,646		672	682		887	900
I18	Invermere	L	ESSFdk 1	3	551	1,267	1,442	4.7	63	78	-	-	-
I18	Invermere	L	ESSFdku	3	-	80	469	-	-	-	-	-	-
I18	Invermere	L	IDF dm 2	4	1,230	1,776	9,811	4.3	76	82	-	-	-
I18	Invermere	L	IDF xk	4	447	587	9,806	4.3	25	32	-	-	-
I18	Invermere	L	MS dk	3	1,949	2,361	4,502	4.7	111	112	-	-	-
Invermere Total					4,177	6,070	26,030		275	304		-	-
I19	Fenwick	I	AT un	5	-	-	733	-	-	-	-	-	-
I19	Fenwick	I	ESSFdk 1	3	1,696	4,013	5,256	14.0	562	562	-	-	-
I19	Fenwick	I	ESSFdku	3	38	727	3,343	14.0	102	104	-	-	-
I19	Fenwick	I	ICH mk 1	3	1,518	2,442	2,660	14.0	342	343	-	-	-
I19	Fenwick	I	MS dk	3	5,314	6,036	6,539	14.0	845	847	26.0	1,569	1,572
Fenwick Total					8,566	13,218	18,531		1,851	1,856		1,569	1,572
I20	Palliser	I	AT un	5	-	-	9,286	-	-	-	-	-	-
I20	Palliser	I	ESSFdk 1	3	1,370	8,882	12,757	14.0	1,243	1,244	-	-	-
I20	Palliser	I	ESSFdku	3	-	2,918	12,962	14.0	409	410	-	-	-
I20	Palliser	I	ICH mk 1	3	856	1,094	1,174	14.0	153	158	-	-	-
I20	Palliser	I	MS dk	3	3,328	5,732	6,330	14.0	802	804	26.0	1,490	1,490
Palliser Total					5,554	18,626	42,509		2,607	2,616		1,490	1,490
I21	Cochran	I	MS dk	3	7,165	8,954	10,502	14.0	1,254	1,262	-	-	-
I21	Cochran	L	AT un	5	-	-	468	-	-	-	-	-	-
I21	Cochran	L	ESSFdk 1	3	1,208	3,500	4,468	4.7	165	165	-	-	-
I21	Cochran	L	ESSFdku	3	-	659	2,532	4.7	31	38	-	-	-
I21	Cochran	L	ICH mk 1	3	1,111	1,679	1,936	4.7	79	80	-	-	-
Cochran Total					9,484	14,793	19,906		1,529	1,545		-	-
I22	Albert	H	AT un	5	-	-	2,852	-	-	-	-	-	-
I22	Albert	H	ESSFdk 1	3	18	33	37	21.0	7	7	34.0	11	14
I22	Albert	H	ESSFdk 2	3	1,107	4,302	6,450	21.0	903	908	34.0	1,463	1,472
I22	Albert	H	ESSFdku	3	186	1,738	7,288	21.0	365	365	-	-	-
I22	Albert	H	ICH mk 1	3	1,170	2,349	2,823	21.0	493	506	-	-	-
I22	Albert	H	MS dk	3	891	1,206	1,332	21.0	253	253	39.0	470	470
Albert Total					3,373	9,628	20,781		2,021	2,039		1,944	1,956
I23	Cross	H	AT un	5	-	245	19,1[illegible]	-	-	-	-	-	-
I23	Cross	H	ESSFdk 1	3	2,338	19,027	32,534	21.0	3,996	4,060	-	-	-
I23	Cross	H	ESSFdku	3	-	5,819	33,107	21.0	1,222	1,246	-	-	-
I23	Cross	H	MS dk	3	3,654	9,727	15,184	21.0	2,043	2,045	-	-	-
Cross Total					5,992	34,818	99,977		7,261	7,351		-	-
I24	Pedley	I	AT un	5	-	117	2,218	-	-	-	-	-	-
I24	Pedley	I	ESSFdk 1	3	710	5,896	11,283	14.0	826	830	-	-	-
I24	Pedley	I	ESSFdku	3	10	1,045	3,902	14.0	146	147	-	-	-
I24	Pedley	I	ICH mk 1	3	2,799	4,696	5,128	14.0	658	664	-	-	-
I24	Pedley	I	MS dk	3	4,973	7,786	12,576	14.0	1,090	1,091	26.0	2,024	2,045
Pedley Total					8,492	19,545	35,199		2,720	2,732		2,024	2,045
I25	Shuswap - Windermere	I	AT un	5	-	309	2,447	-	-	-	-	-	-
I25	Shuswap - Windermere	I	ESSFdk 1	3	689	9,173	13,416	14.0	1,284	1,302	-	-	-
I25	Shuswap - Windermere	I	ESSFdku	3	14	956	2,891	14.0	134	136	-	-	-
I25	Shuswap - Windermere	I	IDF dm 2	4	255	1,525	3,341	13.0	198	199	-	-	-
I25	Shuswap - Windermere	I	IDF xk	4	152	356	8,542	13.0	46	48	-	-	-
I25	Shuswap - Windermere	I	MS dk	3	2,116	6,756	8,035	14.0	946	947	-	-	-
Shuswap - Windermere Total					3,227	19,072	38,673		2,608	2,632		-	-
I26	Horsethief	I	AT un	5	-	-	20,171	-	-	-	-	-	-
I26	Horsethief	I	ESSFdk 1	3	1,069	4,533	6,673	14.0	635	640	-	-	-
I26	Horsethief	I	ESSFdk 2	3	372	3,010	7,153	14.0	421	428	-	-	-
I26	Horsethief	I	ESSFdku	3	7	1,223	14,208	14.0	171	176	-	-	-
I26	Horsethief	I	IDF dm 2	4	84	176	911	13.0	23	23	-	-	-
I26	Horsethief	I	MS dk	3	2,706	4,760	6,859	14.0	666	668	-	-	-
Horsethief Total					4,238	13,702	55,975		1,916	1,935		-	-
I27	Forster	I	AT un	5	-	-	4,423	-	-	-	-	-	-
I27	Forster	I	ESSFdk 1	3	-	5	5	-	-	-	-	-	-
I27	Forster	I	ESSFdk 2	3	446	4,228	5,950	14.0	593	593	-	-	-
I27	Forster	I	ESSFdku	3	-	456	4,669	14.0	64	64	-	-	-
I27	Forster	I	ICH mk 1	3	99	658	755	14.0	92	93	-	-	-
I27	Forster	I	IDF dm 2	4	25	52	54	13.0	7	7	-	-	-
I27	Forster	I	MS dk	3	111	697	745	14.0	98	101	-	-	-
Forster Total					681	6,096	16,602		854	858		-	-
I28	Frances	L	AT un	5	-	-	2,289	-	-	-	-	-	-
I28	Frances	L	ESSFdk 2	3	215	2,019	3,941	4.7	95	101	-	-	-
I28	Frances	L	ESSFdku	3	-	237	4,930	4.7	11	11	-	-	-
I28	Frances	L	ICH mk 1	3	422	760	1,088	4.7	36	36	-	-	-
I28	Frances	L	MS dk	3	5	5	9	-	-	-	-	-	-
Frances Total					642	3,022	12,257		142	148		-	-
I29	Steamboat	I	IDF dm 2	4	9,581	11,187	16,694	13.0	1,454	1,464	-	-	-
I29	Steamboat	I	IDF dm 2n	4	323	418	778	13.0	54	58	-	-	-
I29	Steamboat	I	IDF xk	4	151	304	2,819	13.0	39	42	-	-	-

LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	Old Seral Goals			Old + Mature Seral Goals		
								%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
I29	Steamboat	L	AT un	5	-	-	444	-	-	-	-	-	-
I29	Steamboat	L	ESSFdk 1	3	-	129	152	4.7	7	9	-	-	-
I29	Steamboat	L	ESSFdk 2	3	37	863	1,431	4.7	41	41	-	-	-
I29	Steamboat	L	ESSFdku	3	-	18	1,008	-	-	-	-	-	-
I29	Steamboat	L	ICH mk 1	3	2,035	2,476	2,682	4.7	116	122	-	-	-
I29	Steamboat	L	MS dk	3	4,629	6,146	7,248	4.7	289	290	-	-	-
Steamboat Total					16,754	21,542	33,253		2,000	2,026		-	-
I30	Kindersley - Macauley	L	ESSFdk 1	3	255	2,579	4,150	4.7	121	124	-	-	-
I30	Kindersley - Macauley	L	ESSFdku	3	-	170	1,588	4.7	8	10	-	-	-
I30	Kindersley - Macauley	L	IDF dm 2	4	602	910	7,483	4.3	40	42	-	-	-
I30	Kindersley - Macauley	L	IDF dm 2n	4	138	246	2,321	4.3	11	11	-	-	-
I30	Kindersley - Macauley	L	IDF dk	4	5	10	595	-	-	-	-	-	-
I30	Kindersley - Macauley	L	MS dk	3	1,623	4,012	4,775	4.7	189	189	-	-	-
Kindersley - Macauley Total					2,623	7,927	20,912		369	376		-	-
I31	Bugaboo	I	AT un	5	-	-	9,149	-	-	-	-	-	-
I31	Bugaboo	I	ESSFdk 2	3	2,266	5,335	7,490	14.0	747	747	-	-	-
I31	Bugaboo	I	ESSFdku	3	95	2,031	10,844	14.0	284	285	-	-	-
I31	Bugaboo	I	ICH mk 1	3	634	1,137	1,510	14.0	159	161	-	-	-
I31	Bugaboo	I	MS dk	3	301	517	665	14.0	72	73	-	-	-
Bugaboo Total					3,296	9,020	29,658		1,262	1,266		-	-
I32	Dunbar - Templeton	I	AT un	5	-	-	3,015	-	-	-	-	-	-
I32	Dunbar - Templeton	I	ESSFdk 2	3	508	1,432	2,509	14.0	200	201	-	-	-
I32	Dunbar - Templeton	I	ESSFdku	3	-	311	3,562	14.0	43	44	-	-	-
I32	Dunbar - Templeton	I	ICH mk 1	3	1,939	2,323	2,644	14.0	325	333	-	-	-
I32	Dunbar - Templeton	I	IDF dm 2n	4	1,487	1,863	4,783	13.0	242	251	-	-	-
I32	Dunbar - Templeton	I	MS dk	3	6,194	7,446	8,680	14.0	1,042	1,047	-	-	-
Dunbar - Templeton Total					10,128	13,374	25,193		1,852	1,876		-	-
I33	Luxor	I	ESSFdk 1	3	552	2,516	3,617	14.0	352	356	-	-	-
I33	Luxor	I	ESSFdku	3	3	125	1,952	14.0	18	24	-	-	-
I33	Luxor	I	ICH mk 1	3	541	823	877	14.0	115	116	-	-	-
I33	Luxor	I	IDF dm 2	4	269	424	545	13.0	55	55	-	-	-
I33	Luxor	I	MS dk	3	1,411	2,159	2,293	14.0	302	302	-	-	-
Luxor Total					2,777	6,046	9,284		842	853		-	-
I36	McMurdo - Fraling	L	ESSFdk 1	3	136	3,206	6,651	4.7	153	153	-	-	-
I36	McMurdo - Fraling	L	ESSFdku	3	-	41	2,252	-	-	-	-	-	-
I36	McMurdo - Fraling	L	ICH mk 1	3	2,884	5,987	10,278	4.7	285	285	-	-	-
I36	McMurdo - Fraling	L	IDF dm 2n	4	290	707	12,818	4.3	30	35	-	-	-
I36	McMurdo - Fraling	L	MS dk	3	24	72	204	-	-	-	-	-	-
McMurdo - Fraling Total					3,335	10,014	32,203		468	473		-	-
Invermere Totals					233,873	584,648	1,153,073		86,868	87,497		21,005	21,004
										100.9%			100.0%

Appendix E – THLB and CFLB Areas by BEC/BEO


BEC Variants in the CFLB by BEO
CFLB Area (ha)
PP dh 2
6,721
MS dk
162,060
IDF xk
2,802
IDF dm 2n
3,234
IDF dm 2
50,608
ICH mk 1
50,041
ESSFwmu
291
ESSFwm
1,722
ESSFdku
53,200
ESSFdk 2
26,305
ESSFdk 1
196,694
AT un
969
0
50000
100000
150000
200000
250000
CFLB Area (ha)
☐ Low BEO
■ Inter BEO
▨ High BEO


BEC Variants in the THLB by BEO
THLB Area (ha)
PP dh 2
5,067
MS dk
99,627
IDF xk
1,732
IDF dm 2n
2,238
IDF dm 2
37,494
ICH mk 1
32,285
ESSFwmu
22
ESSFwm
758
ESSFdku
1,361
ESSFdk 2
6,180
ESSFdk 1
51,506
AT un
0
0
20000
40000
60000
80000
100000
120000
THLB Area (ha)
☐ Low BEO
■ Inter BEO
▨ High BEO

Appendix F – Analysis Unit Volumes

Invermere Effective Yields by AU (Existing Stands)

	Existing Natural Stands																			Existing Managed Stands						
	101	103	104	105	106	107	108	109	110	111	112	114	115	116	117	118	119	150	151	501	502	503	504	505	506	507
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0
30	0	0	0	2	0	0	2	3	0	1	25	0	1	22	0	0	3	0	0	0	32	19	2	30	27	14
40	3	0	6	31	0	6	31	25	2	32	77	3	32	73	0	2	26	0	0	3	99	72	16	92	88	57
50	19	3	26	66	2	24	73	59	22	70	123	31	70	119	1	19	58	0	0	18	158	132	55	156	154	106
60	39	17	51	101	6	62	125	89	43	104	163	61	105	159	10	44	93	13	0	37	208	189	166	211	205	153
70	58	33	75	134	25	100	172	118	75	134	198	88	136	194	27	70	128	33	4	55	252	235	157	257	250	194
80	77	49	98	165	50	135	213	145	98	162	229	113	163	224	46	96	162	52	23	73	284	276	200	296	286	231
90	95	65	120	196	77	165	240	167	120	187	256	136	189	253	65	122	196	70	42	90	315	312	237	323	313	264
100	112	80	142	225	104	193	260	187	141	211	284	157	213	279	85	147	228	87	60	108	341	337	270	345	335	291
110	129	95	162	252	129	217	308	203	160	233	309	177	235	303	104	171	259	104	78	121	361	357	300	365	347	314
120	143	108	181	275	151	239	332	217	178	253	331	196	255	325	122	194	287	120	94	136	381	376	328	381	358	334
130	157	121	199	297	173	261	354	235	195	272	352	214	275	345	140	215	313	134	109	148	397	389	348	393	367	353
140	169	132	214	315	189	280	373	252	208	285	365	227	288	360	155	234	334	148	122	159	410	401	368	405	373	370
150	180	142	227	330	211	297	389	268	218	296	377	238	299	370	165	246	348	157	133	170	417	410	386	414	380	384
160	190	150	237	347	228	311	402	280	226	303	384	245	306	378	172	254	356	165	143	179	424	418	402	420	385	396
170	198	158	247	[illegible]	242	324	414	297	231	308	388	251	311	382	177	258	360	172	152	187	430	426	416	425	387	406
180	207	164	255	364	256	336	424	310	234	310	389	254	313	383	179	260	361	179	159	194	434	430	426	429	389	416
190	214	171	263	373	266	347	433	323	234	310	389	256	313	383	180	261	362	186	167	202	436	436	434	431	391	422
200	222	178	271	382	279	357	442	336	237	312	390	257	316	384	182	263	363	191	174	209	437	437	446	432	393	429
210	229	184	279	390	290	366	450	349	240	315	392	260	319	387	184	265	365	197	181	215	437	440	453	432	393	436
220	235	190	286	398	300	375	457	362	243	317	395	263	321	389	185	267	366	202	188	222	437	441	459	432	393	441
230	242	195	293	406	309	383	463	375	246	320	397	266	324	392	186	268	367	206	195	228	437	441	467	433	393	446
240	249	201	299	413	318	391	470	389	248	323	400	269	327	395	188	269	368	211	201	234	437	443	472	434	393	449
250	255	206	305	420	325	398	475	402	251	325	402	271	329	397	188	271	369	215	207	240	437	443	476	434	393	451
260	258	206	305	420	331	401	479	403	253	327	404	273	331	399	189	271	370	217	209	241	437	443	478	434	393	453
270	259	207	306	421	336	404	480	403	256	329	406	275	333	401	189	271	370	218	210	242	437	443	481	434	393	456
280	259	207	306	421	340	408	482	404	258	330	408	277	334	402	189	271	370	219	212	244	437	443	483	434	393	457
290	260	207	307	421	344	408	484	405	258	332	409	278	336	404	189	271	371	221	213	245	437	443	486	434	393	459
300	261	208	307	421	348	410	486	406	259	333	411	279	337	405	189	271	371	222	214	246	437	443	486	434	393	459
310	262	208	307	422	351	412	487	406	260	334	412	280	338	406	189	271	371	223	215	246	437	443	486	434	393	459
320	263	208	307	422	354	414	488	406	261	335	413	281	339	407	189	271	371	224	216	246	437	443	486	434	393	459
330	263	208	307	422	357	415	489	407	262	336	414	282	340	408	189	271	371	225	217	246	437	443	486	434	393	459
340	264	208	309	422	359	416	490	407	262	337	415	283	341	409	189	271	371	226	217	246	437	443	486	434	393	459
350	265	208	309	422	362	419	491	407	263	337	416	283	341	410	189	271	371	227	218	246	437	443	486	434	393	459

Invermere Effective Yields by AU (Managed Stands)

	Future Managed Stands																								
	201	203	204	205	206	207	208	209	210	211	212	214	215	216	217	218	219	251	601	602	603	604	605	606	607
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	1	1	3	1	1	2	0	0	0	0	0	1	1	0	1	1	0
30	0	4	5	11	0	2	7	0	27	36	48	25	30	39	0	1	3	0	0	34	20	2	31	28	14
40	3	29	40	51	7	25	56	5	85	103	121	81	94	108	13	17	34	1	3	100	75	17	95	91	60
50	18	73	88	106	41	83	136	34	143	163	183	139	153	169	52	60	92	7	18	160	138	58	160	159	109
60	37	119	142	164	95	154	210	85	192	213	235	187	202	221	100	113	153	17	37	211	196	110	216	213	156
70	55	167	189	211	153	212	279	138	233	258	277	228	244	265	148	162	207	28	55	253	242	164	262	257	198
80	73	204	226	248	200	269	330	191	267	289	309	263	279	295	191	205	251	38	73	286	284	208	300	294	234
90	90	234	259	284	247	313	365	240	294	315	337	292	305	324	227	242	291	47	90	316	318	244	328	321	267
100	108	262	287	311	287	342	390	275	316	337	362	312	327	346	260	275	326	57	108	342	343	275	350	342	294
110	121	284	311	337	317	366	412	302	335	359	380	331	348	366	287	303	359	66	121	365	362	304	368	354	317
120	135	305	332	360	338	384	426	325	352	374	395	348	363	382	312	330	388	74	135	383	380	329	384	386	338
130	148	322	352	376	355	398	436	346	365	388	407	361	377	395	337	353	411	81	148	397	393	353	397	374	356
140	159	337	365	387	368	410	442	382	377	397	415	374	389	405	356	372	430	88	159	411	406	372	408	380	374
150	170	349	376	396	379	418	444	377	387	407	420	385	398	413	374	392	446	94	170	418	413	391	415	387	387
160	179	359	384	406	387	425	446	389	394	411	425	392	406	417	388	406	460	99	179	424	421	405	423	391	398
170	187	368	392	414	395	427	447	400	400	415	428	400	411	422	400	418	473	103	187	430	428	417	428	394	409
180	194	373	397	414	401	429	448	409	404	418	428	404	415	426	411	428	484	108	194	435	433	429	431	397	417
190	202	378	402	414	403	429	449	415	409	421	428	410	418	428	421	437	492	111	202	438	437	438	432	398	425
200	209	382	406	414	408	430	449	421	411	421	428	413	421	431	429	445	500	115	209	439	438	446	433	399	432
210	215	385	407	414	409	431	449	424	413	421	428	416	421	431	436	455	506	119	215	439	441	455	435	399	439
220	222	387	407	414	409	431	449	428	413	424	428	417	423	431	443	461	511	122	222	439	442	462	435	399	443
230	228	388	407	414	409	431	449	431	414	424	428	417	423	431	451	467	511	126	228	439	443	468	435	399	448
240	234	388	407	414	409	431	449	436	415	424	428	420	423	431	455	471	511	129	234	439	444	472	435	399	449
250	240	388	407	414	409	431	449	439	415	424	428	420	423	431	460	475	511	132	240	439	444	476	435	399	452
260	241	388	407	414	409	431	449	441	415	424	428	420	423	431	463	479	511	133	241	439	444	480	435	399	456
270	242	388	407	414	409	431	449	445	415	424	428	420	423	431	465	481	511	134	242	439	444	483	435	399	457
280	244	388	407	414	409	431	449	446	415	424	428	420	423	431	468	482	511	134	244	439	444	484	435	399	458
290	245	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	135	245	439	444	485	435	399	460
300	246	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	136	246	439	444	485	435	399	460
310	246	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	136	246	439	444	485	435	399	460
320	247	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	137	246	439	444	485	435	399	460
330	248	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	137	246	439	444	485	435	399	460
340	248	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	137	246	439	444	485	435	399	460
350	249	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	138	246	439	444	485	435	399	460

Appendix D – Old and Mature Biodiversity Targets

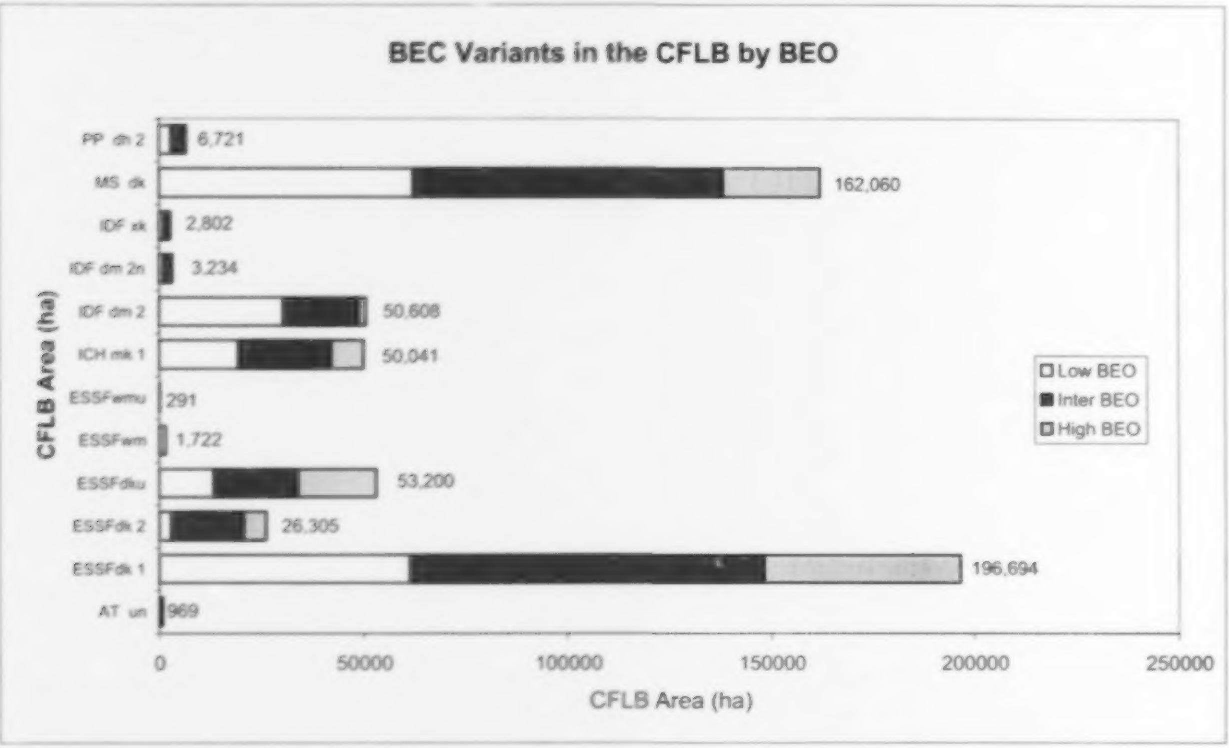
Invermere TSA: Landscape Unit Area Summary by BEC Variant

LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	Old Seral Goals			Old + Mature Seral Goals		
								%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
I01	Findlay	H	AT un	5	-	289	7,781	-	-	-	-	-	-
I01	Findlay	H	ESSFdk 1	3	1,005	11,170	18,792	21.0	2,346	2,432	34.0	3,798	3,799
I01	Findlay	H	ESSFdku	3	4	4,199	20,036	21.0	882	890	-	-	-
I01	Findlay	H	IDF dm 2	4	-	-	241	-	-	-	-	-	-
I01	Findlay	H	MS dk	3	1,294	5,397	6,933	21.0	1,133	1,134	-	-	-
	Findlay Total				2,303	21,055	53,782		4,361	4,456		3,798	3,799
I02	Buhl - Bradford	H	AT un	5	-	-	2,076	-	-	-	-	-	-
I02	Buhl - Bradford	H	ESSFdk 1	3	2,453	13,598	18,261	21.0	2,856	2,856	34.0	4,623	4,627
I02	Buhl - Bradford	H	ESSFdku	3	89	7,216	22,331	21.0	1,515	1,520	-	-	-
I02	Buhl - Bradford	H	ICH mk 1	3	2,168	3,239	3,569	21.0	680	681	-	-	-
I02	Buhl - Bradford	H	MS dk	3	1,172	2,346	2,887	21.0	493	493	39.0	915	916
	Buhl - Bradford Total				5,883	26,399	49,124		5,544	5,550		5,538	5,543
I03	Skookumchuck - Torrent	L	ESSFdk 1	3	1,656	4,375	5,541	4.7	206	206	-	-	-
I03	Skookumchuck - Torrent	L	ESSFdku	3	-	495	1,549	4.7	23	49	-	-	-
I03	Skookumchuck - Torrent	L	ICH mk 1	3	6,295	8,290	9,263	4.7	390	394	-	-	-
I03	Skookumchuck - Torrent	L	IDF dm 2	4	4,659	6,149	9,568	4.3	264	267	-	-	-
I03	Skookumchuck - Torrent	L	MS dk	3	1,374	3,048	3,614	4.7	143	145	-	-	-
I03	Skookumchuck - Torrent	L	PP dh 2	4	1,739	2,862	5,960	4.3	123	141	-	-	-
	Skookumchuck - Torrent Total				15,723	25,220	35,495		1,149	1,202		-	-
I04	Premier - Diorite	I	PP dh 2	4	2,746	3,859	6,443	13.0	502	503	-	-	-
I04	Premier - Diorite	L	AT un	5	-	-	156	-	-	-	-	-	-
I04	Premier - Diorite	L	ESSFdk 1	3	220	2,463	3,831	4.7	116	125	-	-	-
I04	Premier - Diorite	L	ESSFdku	3	-	597	4,203	4.7	28	34	-	-	-
I04	Premier - Diorite	L	IDF dm 2	4	7,839	11,175	23,310	4.3	481	484	-	-	-
I04	Premier - Diorite	L	IDF xk	4	-	11	136	-	-	-	-	-	-
I04	Premier - Diorite	L	MS dk	3	2,825	4,511	5,162	4.7	212	216	-	-	-
	Premier - Diorite Total				13,630	22,616	43,242		1,339	1,339		-	-
I05	Lussier - Coyote	L	AT un	5	-	10	1,729	-	-	-	-	-	-
I05	Lussier - Coyote	L	ESSFdk 1	3	7,333	18,868	23,582	4.7	887	910	-	-	-
I05	Lussier - Coyote	L	ESSFdku	3	297	4,302	13,399	4.7	202	221	-	-	-
I05	Lussier - Coyote	L	IDF dm 2	4	1,253	1,785	2,770	4.3	77	77	-	-	-
I05	Lussier - Coyote	L	MS dk	3	8,473	12,503	13,985	4.7	588	589	-	-	-
	Lussier - Coyote Total				17,356	37,468	55,465		1,754	1,797		-	-
I06	Blackfoot - Thunder	L	AT un	5	-	-	3,891	-	-	-	-	-	-
I06	Blackfoot - Thunder	L	ESSFdk 1	3	3,997	7,411	9,734	4.7	348	349	-	-	-
I06	Blackfoot - Thunder	L	ESSFdku	3	138	1,261	7,174	4.7	59	59	-	-	-
I06	Blackfoot - Thunder	L	MS dk	3	2,199	3,309	3,617	4.7	156	157	-	-	-
	Blackfoot - Thunder Total				6,334	11,981	24,417		563	565		-	-
I07	East-Middle White	I	AT un	5	-	-	4,734	-	-	-	-	-	-
I07	East-Middle White	I	ESSFdk 1	3	4,496	15,830	20,255	14.0	2,216	2,217	-	-	-
I07	East-Middle White	I	ESSFdku	3	27	2,893	13,324	14.0	405	408	-	-	-
I07	East-Middle White	I	MS dk	3	3,032	4,064	4,401	14.0	569	582	-	-	-
	East-Middle White Total				7,555	22,787	42,714		3,190	3,207		-	-
I08	North White	I	AT un	5	-	-	3,233	-	-	-	-	-	-
I08	North White	I	ESSFdk 1	3	6,351	9,948	12,714	14.0	1,393	1,393	-	-	-
I08	North White	I	ESSFdku	3	98	1,789	8,495	14.0	250	254	-	-	-
I08	North White	I	MS dk	3	1,776	2,136	2,338	14.0	299	299	-	-	-
	North White Total				8,225	13,872	25,780		1,942	1,946		-	-
I09	Grave	I	AT un	5	-	-	1,375	-	-	-	-	-	-
I09	Grave	I	ICH mk 1	3	1,730	3,238	3,482	14.0	453	453	-	-	-
I09	Grave	L	AT un	5	-	-	53	-	-	-	-	-	-
I09	Grave	L	ESSFdk 1	3	2,709	7,524	10,200	4.7	354	354	-	-	-
I09	Grave	L	ESSFdku	3	18	1,294	6,355	4.7	61	61	-	-	-
I09	Grave	L	MS dk	3	6,811	9,547	10,828	4.7	449	453	-	-	-
	Grave Total				11,268	21,603	32,292		1,317	1,321		-	-
I10	Nine Mile - Moscow	I	ESSFdk 2	3	1,134	3,698	5,274	14.0	518	527	-	-	-
I10	Nine Mile - Moscow	I	ICH mk 1	3	4,699	6,361	6,922	14.0	890	891	-	-	-
I10	Nine Mile - Moscow	L	AT un	5	-	-	119	-	-	-	-	-	-
I10	Nine Mile - Moscow	L	ESSFdk 1	3	567	2,209	3,482	4.7	104	104	-	-	-
I10	Nine Mile - Moscow	L	ESSFdku	3	14	785	5,046	4.7	37	49	-	-	-
I10	Nine Mile - Moscow	L	IDF dm 2	4	2,764	3,302	4,309	4.3	142	142	-	-	-
I10	Nine Mile - Moscow	L	MS dk	3	6,108	8,626	9,801	4.7	405	407	-	-	-
	Nine Mile - Moscow Total				15,287	24,981	34,953		2,096	2,120		-	-
I11	Kootenay	H	AT un	5	-	-	5	-	-	-	-	-	-
I11	Kootenay	H	ESSFdk 1	3	1,202	3,327	5,846	21.0	699	701	34.0	1,131	1,133
I11	Kootenay	H	ESSFdku	3	-	58	1,179	21.0	12	15	-	-	-
I11	Kootenay	H	ICH mk 1	3	1,165	2,487	2,959	21.0	522	523	-	-	-
I11	Kootenay	H	IDF dm 2	4	454	1,147	1,534	19.0	218	218	-	-	-
I11	Kootenay	H	IDF xk	4	68	98	937	19.0	19	19	-	-	-
I11	Kootenay	H	MS dk	3	2,392	3,519	4,289	21.0	739	739	39.0	1,373	1,375
	Kootenay Total				5,282	10,637	16,750		2,209	2,215		2,504	2,508
I12	Doctor - Fir	L	AT un	5	-	-	1,800	-	-	-	-	-	-
I12	Doctor - Fir	L	ESSFdk 1	3	2,642	7,831	9,551	4.7	368	369	-	-	-
I12	Doctor - Fir	L	ESSFdku	3	33	3,322	7,613	4.7	156	157	-	-	-
I12	Doctor - Fir	L	IDF dm 2	4	3,676	5,206	11,663	4.3	224	227	-	-	-
I12	Doctor - Fir	L	IDF xk	4	197	384	5,086	4.3	17	19	-	-	-
I12	Doctor - Fir	L	MS dk	3	5,320	7,892	10,178	4.7	371	371	-	-	-
	Doctor - Fir Total				11,868	24,634	45,891		1,136	1,143		-	-
I13	East Columbia	I	AT un	5	-	-	123	-	-	-	-	-	-
I13	East Columbia	I	ESSFdk 1	3	348	2,347	3,952	14.0	329	330	-	-	-
I13	East Columbia	I	ESSFdku	3	-	127	1,429	14.0	18	24	-	-	-
I13	East Columbia	I	IDF dm 2	4	1,280	2,598	3,573	13.0	338	341	-	-	-
I13	East Columbia	I	IDF xk	4	569	1,026	6,075	13.0	133	137	-	-	-
I13	East Columbia	I	MS dk	3	2,329	4,522	5,259	14.0	633	644	-	-	-
	East Columbia Total				4,526	10,621	20,410		1,451	1,476		-	-
I14	Brewer - Dutch	I	AT un	5	-	-	6,253	-	-	-	-	-	-
I14	Brewer - Dutch	I	ESSFdk 1	3	3,997	16,419	22,776	14.0	2,299	2,306	-	-	-
I14	Brewer - Dutch	I	ESSFdku	3	168	4,813	22,638	14.0	674	674	-	-	-
I14	Brewer - Dutch	I	IDF dm 2	4	1,615	2,368	4,546	13.0	311	313	-	-	-
I14	Brewer - Dutch	I	IDF xk	4	-	28	139	-	-	-	-	-	-
I14	Brewer - Dutch	I	MS dk	3	4,158	8,816	11,021	14.0	1,234	1,237	-	-	-
	Brewer - Dutch Total				9,937	32,443	67,374		4,518	4,530		-	-

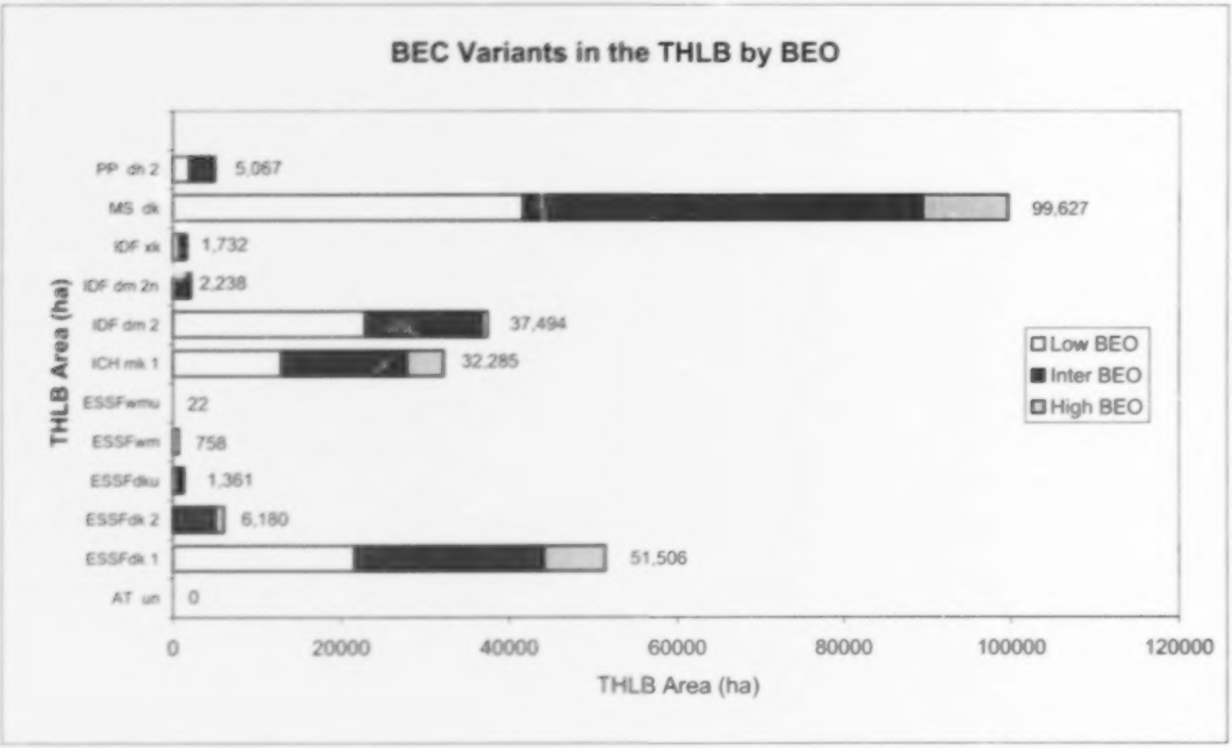
								Old Seral Goals			Old + Mature Seral Goals		
LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
I15	Toby	I	AT un	5	-	-	7,665	-	-	-	-	-	-
I15	Toby	I	ESSFdk 1	3	660	7,184	15,376	14.0	1,006	1,007	-	-	-
I15	Toby	I	ESSFdku	3	14	1,171	13,491	14.0	164	165	-	-	-
I15	Toby	I	IDF dm 2	4	118	210	286	13.0	27	28	-	-	-
I15	Toby	I	MS dk	3	2,093	5,512	8,437	14.0	772	773	-	-	-
	Toby Total				2,886	14,078	45,254		1,969	1,973		-	-
I16	Jumbo	H	AT un	5	-	-	4,507	-	-	-	-	-	-
I16	Jumbo	H	ESSFdk 1	3	17	56	68	21.0	12	13	34.0	19	14
I16	Jumbo	H	ESSFdk 2	3	95	1,418	2,541	21.0	298	299	34.0	482	490
I16	Jumbo	H	ESSFdku	3	-	128	2,012	21.0	27	31	-	-	-
I16	Jumbo	H	ESSFwm	1	758	1,722	2,499	28.0	482	482	24.0	413	415
I16	Jumbo	H	ESSFwmu	1	22	291	1,820	28.0	81	82	-	-	-
I16	Jumbo	H	MS dk	3	431	864	1,091	21.0	181	182	39.0	337	272
	Jumbo Total				1,322	4,480	14,539		1,081	1,089		1,251	1,191
I17	Goldie	H	AT un	5	-	-	87	-	-	-	-	-	-
I17	Goldie	H	ESSFdk 1	3	142	1,373	2,129	21.0	288	289	34.0	467	473
I17	Goldie	H	ESSFdku	3	-	194	1,506	21.0	41	45	-	-	-
I17	Goldie	H	IDF dm 2	4	413	618	2,529	19.0	117	121	-	-	-
I17	Goldie	H	MS dk	3	567	1,077	1,395	21.0	226	227	39.0	420	427
	Goldie Total				1,122	3,262	7,646		672	682		887	900
I18	Invermere	L	ESSFdk 1	3	551	1,267	1,442	4.7	63	78	-	-	-
I18	Invermere	L	ESSFdku	3	-	80	469	-	-	-	-	-	-
I18	Invermere	L	IDF dm 2	4	1,230	1,776	9,811	4.3	76	82	-	-	-
I18	Invermere	L	IDF xk	4	447	587	9,806	4.3	25	32	-	-	-
I18	Invermere	L	MS dk	3	1,949	2,361	4,502	4.7	111	112	-	-	-
	Invermere Total				4,177	6,070	26,030		275	304		-	-
I19	Fenwick	I	AT un	5	-	-	733	-	-	-	-	-	-
I19	Fenwick	I	ESSFdk 1	3	1,696	4,013	5,256	14.0	562	562	-	-	-
I19	Fenwick	I	ESSFdku	3	38	727	3,343	14.0	102	104	-	-	-
I19	Fenwick	I	ICH mk 1	3	1,518	2,442	2,660	14.0	342	343	-	-	-
I19	Fenwick	I	MS dk	3	5,314	6,036	6,539	14.0	845	847	26.0	1,569	1,572
	Fenwick Total				8,566	13,218	18,531		1,851	1,856		1,569	1,572
I20	Palliser	I	AT un	5	-	-	9,286	-	-	-	-	-	-
I20	Palliser	I	ESSFdk 1	3	1,376	8,882	12,757	14.0	1,243	1,244	-	-	-
I20	Palliser	I	ESSFdku	3	-	2,918	12,962	14.0	409	410	-	-	-
I20	Palliser	I	ICH mk 1	3	856	1,094	1,174	14.0	153	158	-	-	-
I20	Palliser	I	MS dk	3	3,326	5,732	6,330	14.0	802	804	26.0	1,490	1,490
	Palliser Total				5,558	18,626	42,509		2,607	2,616		1,490	1,490
I21	Cochran	I	MS dk	3	7,166	8,954	10,502	14.0	1,254	1,262	-	-	-
I21	Cochran	L	AT un	5	-	-	468	-	-	-	-	-	-
I21	Cochran	L	ESSFdk 1	3	1,208	3,500	4,468	4.7	165	165	-	-	-
I21	Cochran	L	ESSFdku	3	-	659	2,532	4.7	31	38	-	-	-
I21	Cochran	L	ICH mk 1	3	1,111	1,679	1,936	4.7	79	80	-	-	-
	Cochran Total				9,484	14,793	19,906		1,529	1,545		-	-
I22	Albert	H	AT un	5	-	-	2,852	-	-	-	-	-	-
I22	Albert	H	ESSFdk 1	3	18	33	37	21.0	7	7	34.0	11	14
I22	Albert	H	ESSFdk 2	3	1,107	4,302	6,450	21.0	903	908	34.0	1,463	1,472
I22	Albert	H	ESSFdku	3	186	1,738	7,288	21.0	365	365	-	-	-
I22	Albert	H	ICH mk 1	3	1,170	2,349	2,823	21.0	493	506	-	-	-
I22	Albert	H	MS dk	3	891	1,206	1,332	21.0	253	253	39.0	470	470
	Albert Total				3,373	9,628	20,781		2,021	2,039		1,944	1,956
I23	Cross	H	AT un	5	-	245	19,152	-	-	-	-	-	-
I23	Cross	H	ESSFdk 1	3	2,338	19,027	32,534	21.0	3,996	4,060	-	-	-
I23	Cross	H	ESSFdku	3	-	5,819	33,107	21.0	1,222	1,246	-	-	-
I23	Cross	H	MS dk	3	3,654	9,727	15,184	21.0	2,043	2,045	-	-	-
	Cross Total				5,992	34,818	99,977		7,261	7,351		-	-
I24	Pedley	I	AT un	5	-	117	2,218	-	-	-	-	-	-
I24	Pedley	I	ESSFdk 1	3	710	5,898	11,283	14.0	826	830	-	-	-
I24	Pedley	I	ESSFdku	3	10	1,045	3,992	14.0	146	147	-	-	-
I24	Pedley	I	ICH mk 1	3	2,799	4,698	5,128	14.0	658	664	-	-	-
I24	Pedley	I	MS dk	3	4,973	7,786	12,578	14.0	1,090	1,091	26.0	2,024	2,045
	Pedley Total				8,492	19,545	35,199		2,720	2,732		2,024	2,045
I25	Shuswap - Windermere	I	AT un	5	-	309	2,447	-	-	-	-	-	-
I25	Shuswap - Windermere	I	ESSFdk 1	3	689	9,173	13,416	14.0	1,284	1,302	-	-	-
I25	Shuswap - Windermere	I	ESSFdku	3	14	955	2,891	14.0	134	136	-	-	-
I25	Shuswap - Windermere	I	IDF dm 2	4	255	1,525	3,341	13.0	198	199	-	-	-
I25	Shuswap - Windermere	I	IDF xk	4	152	355	8,542	13.0	46	48	-	-	-
I25	Shuswap - Windermere	I	MS dk	3	2,116	6,755	8,035	14.0	946	947	-	-	-
	Shuswap - Windermere Total				3,227	19,072	38,673		2,608	2,632		-	-
I26	Horsethief	I	AT un	5	-	-	20,171	-	-	-	-	-	-
I26	Horsethief	I	ESSFdk 1	3	1,089	4,533	6,673	14.0	635	640	-	-	-
I26	Horsethief	I	ESSFdk 2	3	372	3,010	7,153	14.0	421	428	-	-	-
I26	Horsethief	I	ESSFdku	3	7	1,223	14,208	14.0	171	176	-	-	-
I26	Horsethief	I	IDF dm 2	4	84	176	911	13.0	23	23	-	-	-
I26	Horsethief	I	MS dk	3	2,706	4,760	6,859	14.0	666	668	-	-	-
	Horsethief Total				4,258	13,702	55,975		1,916	1,935		-	-
I27	Forster	I	AT un	5	-	-	4,423	-	-	-	-	-	-
I27	Forster	I	ESSFdk 1	3	-	5	5	-	-	-	-	-	-
I27	Forster	I	ESSFdk 2	3	446	4,228	5,950	14.0	593	593	-	-	-
I27	Forster	I	ESSFdku	3	-	456	4,669	14.0	64	64	-	-	-
I27	Forster	I	ICH mk 1	3	99	658	755	14.0	92	93	-	-	-
I27	Forster	I	IDF dm 2	4	25	52	54	13.0	7	7	-	-	-
I27	Forster	I	MS dk	3	111	697	745	14.0	98	101	-	-	-
	Forster Total				681	6,096	16,602		854	858		-	-
I28	Frances	L	AT un	5	-	-	2,289	-	-	-	-	-	-
I28	Frances	L	ESSFdk 2	3	215	2,019	3,941	4.7	95	101	-	-	-
I28	Frances	L	ESSFdku	3	-	237	4,930	4.7	11	11	-	-	-
I28	Frances	L	ICH mk 1	3	422	760	1,088	4.7	36	36	-	-	-
I28	Frances	L	MS dk	3	5	5	9	-	-	-	-	-	-
	Frances Total				642	3,022	12,257		142	148		-	-
I29	Steamboat	I	IDF dm 2	4	9,581	11,187	16,694	13.0	1,454	1,464	-	-	-
I29	Steamboat	I	IDF dm 2n	4	323	418	778	13.0	54	58	-	-	-
I29	Steamboat	I	IDF xk	4	151	304	2,819	13.0	39	42	-	-	-

								Old Seral Goals			Old + Mature Seral Goals		
LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
I29	Steamboat	L	AT un	5	-	-	444	-	-	-	-	-	-
I29	Steamboat	L	ESSFdk 1	3	-	129	152	4.7	7	9	-	-	-
I29	Steamboat	L	ESSFdk 2	3	37	863	1,431	4.7	41	41	-	-	-
I29	Steamboat	L	ESSFdku	3	-	18	1,008	-	-	-	-	-	-
I29	Steamboat	L	ICH mk 1	3	2,035	2,476	2,682	4.7	116	122	-	-	-
I29	Steamboat	L	MS dk	3	4,629	6,146	7,248	4.7	289	290	-	-	-
Steamboat Total					16,754	21,542	33,253		2,000	2,026		-	-
I30	Kindersley - Macauley	L	ESSFdk 1	3	255	2,579	4,150	4.7	121	124	-	-	-
I30	Kindersley - Macauley	L	ESSFdku	3	-	170	1,58[illegible]	4.7	8	10	-	-	-
I30	Kindersley - Macauley	L	IDF dm 2	4	602	910	7,4[illegible]	4.3	40	42	-	-	-
I30	Kindersley - Macauley	L	IDF dm 2n	4	138	246	2,3[illegible]	4.3	11	11	-	-	-
I30	Kindersley - Macauley	L	IDF xk	4	5	10	595	-	-	-	-	-	-
I30	Kindersley - Macauley	L	MS dk	3	1,623	4,012	4,775	4.7	189	189	-	-	-
Kindersley - Macauley Total					2,623	7,927	20,912		369	376		-	-
I31	Bugaboo	I	AT un	5	-	-	9,149	-	-	-	-	-	-
I31	Bugaboo	I	ESSFdk 2	3	2,268	5,335	7,490	14.0	747	747	-	-	-
I31	Bugaboo	I	ESSFdku	3	95	2,031	10,844	14.0	284	285	-	-	-
I31	Bugaboo	I	ICH mk 1	3	634	1,137	1,510	14.0	159	161	-	-	-
I31	Bugaboo	I	MS dk	3	301	517	665	14.0	72	73	-	-	-
Bugaboo Total					3,298	9,020	29,658		1,262	1,266		-	-
I32	Dunbar - Templeton	I	AT un	5	-	-	3,015	-	-	-	-	-	-
I32	Dunbar - Templeton	I	ESSFdk 2	3	508	1,432	2,509	14.0	200	201	-	-	-
I32	Dunbar - Templeton	I	ESSFdku	3	-	311	3,562	14.0	43	44	-	-	-
I32	Dunbar - Templeton	I	ICH mk 1	3	1,939	2,323	2,644	14.0	325	333	-	-	-
I32	Dunbar - Templeton	I	IDF dm 2n	4	1,487	1,863	4,783	13.0	242	251	-	-	-
I32	Dunbar - Templeton	I	MS dk	3	6,194	7,446	8,680	14.0	1,042	1,047	-	-	-
Dunbar - Templeton Total					10,128	13,374	25,193		1,852	1,876		-	-
I33	Luxor	I	ESSFdk 1	3	552	2,516	3,617	14.0	352	356	-	-	-
I33	Luxor	I	ESSFdku	3	3	125	1,952	14.0	18	24	-	-	-
I33	Luxor	I	ICH mk 1	3	541	823	877	14.0	115	116	-	-	-
I33	Luxor	I	IDF dm 2	4	269	424	545	13.0	55	55	-	-	-
I33	Luxor	I	MS dk	3	1,411	2,159	2,293	14.0	302	302	-	-	-
Luxor Total					2,777	6,046	9,284		842	853		-	-
I36	McMurdo - Fraling	L	ESSFdk 1	3	136	3,206	6,651	4.7	153	153	-	-	-
I36	McMurdo - Fraling	L	ESSFdku	3	-	41	2,252	-	-	-	-	-	-
I36	McMurdo - Fraling	L	ICH mk 1	3	2,884	5,987	10,278	4.7	285	285	-	-	-
I36	McMurdo - Fraling	L	IDF dm 2n	4	290	707	12,818	4.3	30	35	-	-	-
I36	McMurdo - Fraling	L	MS dk	3	24	72	204	-	-	-	-	-	-
McMurdo - Fraling Total					3,335	10,014	32,203		468	473		-	-
Invermere Totals					233,873	554,648	1,153,073		66,868	67,497		21,006	21,004
										100.9%			100.0%

Appendix E – THLB and CFLB Areas by BEC/BEO



BEC Variants in the CFLB by BEO



BEC Variants in the THLB by BEO

Appendix F – Analysis Unit Volumes

Invermere Effective Yields by AU (Existing Stands)

	Existing Natural Stands																			Existing Managed Stands						
	101	103	104	105	106	107	108	109	110	111	112	114	115	116	117	118	119	150	151	501	502	503	504	505	506	507
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0
30	0	0	0	2	0	0	2	3	0	1	25	0	1	22	0	0	3	0	0	0	32	19	2	30	27	14
40	3	0	5	31	0	6	21	25	2	32	77	3	32	73	0	2	26	0	0	3	99	72	16	82	88	57
50	19	3	26	66	2	24	73	56	22	70	123	31	70	119	1	19	58	0	0	18	156	132	55	156	154	106
60	39	17	51	101	8	62	125	89	49	104	163	61	105	159	10	44	93	13	0	37	209	189	105	211	205	153
70	58	33	75	134	25	100	172	118	75	134	198	88	136	194	27	70	128	33	4	55	252	235	157	257	250	194
80	77	49	98	165	50	135	213	145	98	162	229	113	163	224	46	96	162	52	23	73	284	276	200	296	286	231
90	95	65	120	196	77	165	249	167	120	187	258	138	189	253	65	122	196	70	42	90	315	312	237	323	313	264
100	112	80	142	225	104	193	280	187	141	211	286	157	213	279	86	147	229	87	60	106	341	337	270	345	335	291
110	129	95	162	252	129	217	308	203	160	233	309	177	235	303	104	171	259	104	79	121	361	357	300	365	347	314
120	143	108	181	275	151	239	332	217	178	253	331	196	255	325	122	194	287	120	94	135	381	375	325	381	358	334
130	157	121	198	297	173	261	354	235	196	272	352	214	275	346	140	215	313	134	109	149	397	389	348	395	387	353
140	169	132	214	315	193	280	373	252	208	285	360	227	288	360	155	234	334	146	122	160	410	401	369	405	373	370
150	180	142	227	330	211	297	389	268	218	296	377	238	299	370	165	246	348	157	133	170	417	410	386	414	380	384
160	190	150	237	340	228	311	402	283	226	303	384	245	306	378	172	254	356	165	143	170	424	418	402	420	385	396
170	198	156	247	354	242	324	414	297	231	309	388	251	311	382	177	258	360	172	152	187	430	426	416	425	387	406
180	207	164	255	364	256	336	424	310	234	310	389	254	313	383	179	260	361	179	159	194	434	430	426	429	389	416
190	214	171	263	373	260	347	433	323	234	310	390	254	313	385	180	261	362	185	167	202	436	436	434	431	391	422
200	222	178	271	382	279	357	442	336	237	312	390	257	316	384	182	263	363	189	174	208	437	437	445	432	393	429
210	229	184	279	390	290	366	450	348	240	315	392	260	319	387	184	265	365	197	181	215	437	440	453	432	393	436
220	236	190	286	398	300	375	457	362	243	317	395	263	321	389	185	267	366	202	188	222	437	441	459	432	393	441
230	242	195	293	405	309	383	463	375	246	320	397	266	324	392	186	269	367	208	195	228	437	441	467	433	393	446
240	249	201	299	413	318	391	470	389	249	323	400	269	327	395	188	270	369	211	201	234	437	443	472	434	393	449
250	255	205	306	430	330	398	475	402	251	325	402	271	329	397	188	271	369	215	207	240	437	443	476	434	393	451
260	256	206	305	430	331	401	478	403	253	327	404	273	331	399	189	271	370	217	209	241	437	443	479	434	393	453
270	258	207	306	421	335	404	480	403	255	329	406	275	333	401	189	271	370	218	210	242	437	443	481	434	393	456
280	259	207	306	421	340	406	482	404	256	330	408	277	334	402	189	271	370	218	212	244	437	443	483	434	393	457
290	260	207	307	421	344	408	484	405	258	332	409	278	336	404	189	271	371	221	213	245	437	443	485	434	393	459
300	261	208	307	421	345	410	486	405	259	333	411	279	337	405	189	271	371	222	214	246	437	443	485	434	393	459
310	262	208	307	422	351	412	487	406	260	334	412	280	338	406	189	271	371	223	215	246	437	443	485	434	393	459
320	263	208	307	422	356	414	489	406	261	335	413	281	339	407	189	271	371	224	216	246	437	443	486	434	393	459
330	263	208	307	422	357	415	489	407	262	336	414	282	340	408	189	271	371	225	217	246	437	443	486	434	393	459
340	264	208	308	422	359	416	490	407	262	337	415	283	341	409	189	271	371	226	217	246	437	443	486	434	393	459
350	265	208	308	422	362	418	491	407	263	337	416	283	341	410	189	271	371	227	218	246	437	443	486	434	393	459

Invermere Effective Yields by AU (Managed Stands)

	Future Managed Stands																								
	201	**203**	**204**	**205**	**206**	**207**	**208**	**209**	**210**	**211**	**212**	**214**	**215**	**216**	**217**	**218**	**219**	**251**	**601**	**602**	**603**	**604**	**605**	**606**	**607**
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	1	1	3	1	1	2	0	0	3	0	0	1	1	0	1	1	0
30	0	4	5	11	0	2	7	0	27	36	48	25	30	39	0	1	3	0	0	34	20	2	31	28	14
40	3	29	40	51	7	25	56	5	95	103	121	81	94	108	13	17	34	1	3	100	75	17	95	91	60
50	18	73	88	106	41	83	136	34	143	163	183	139	153	169	52	60	92	7	18	160	138	56	160	150	109
60	37	119	142	164	95	154	210	95	192	213	236	187	202	221	100	113	153	17	37	211	198	110	216	213	156
70	55	167	189	211	153	212	279	138	233	258	277	228	244	265	148	162	207	28	55	253	242	164	262	257	198
80	73	204	226	248	200	269	330	191	267	289	309	263	279	295	191	205	251	38	73	288	284	208	300	294	234
90	90	234	259	284	247	313	365	240	294	315	337	292	305	324	227	242	291	47	90	316	318	244	328	321	267
100	106	262	287	311	287	342	390	275	316	337	362	312	327	346	260	275	326	57	106	342	343	275	350	342	294
110	121	284	311	337	317	366	412	302	335	359	380	331	348	366	287	303	359	66	121	365	362	304	368	354	317
120	135	305	332	360	338	384	426	325	352	374	395	348	363	382	312	330	388	74	135	383	380	329	384	366	338
130	148	322	352	376	355	398	436	346	365	388	407	361	377	395	337	353	411	81	148	397	393	353	397	374	356
140	159	337	365	387	368	410	442	362	377	397	415	374	389	405	356	372	430	88	159	411	408	372	408	380	374
150	170	349	376	396	379	418	444	377	387	407	420	385	398	413	374	392	446	94	170	418	413	391	415	387	387
160	179	359	384	406	387	425	446	389	394	411	425	392	408	417	388	406	460	99	179	424	421	405	423	391	398
170	187	368	392	414	395	427	447	400	400	415	428	400	411	422	400	418	473	103	187	430	428	417	428	394	409
180	194	373	397	414	401	429	448	409	404	419	428	404	415	426	411	429	484	108	194	435	433	429	431	397	417
190	202	378	402	414	403	429	449	415	409	421	428	410	418	428	421	437	492	111	202	439	437	438	432	398	425
200	209	382	406	414	408	430	449	421	411	421	428	413	421	431	429	445	500	115	209	439	438	446	433	399	432
210	215	385	407	414	409	431	449	424	413	421	428	416	421	431	436	455	506	119	215	439	441	455	435	399	439
220	222	387	407	414	409	431	449	428	413	424	428	417	423	431	443	461	511	122	222	439	442	462	435	399	443
230	228	388	407	414	409	431	449	431	414	424	428	417	423	431	451	467	511	126	228	439	443	468	435	399	448
240	234	388	407	414	409	431	449	436	415	424	428	420	423	431	455	471	511	129	234	439	444	472	435	399	449
250	240	388	407	414	409	431	449	439	415	424	428	420	423	431	460	475	511	132	240	439	444	476	435	399	452
260	241	388	407	414	409	431	449	441	415	424	428	420	423	431	463	479	511	133	241	439	444	480	435	399	456
270	242	388	407	414	409	431	449	445	415	424	428	420	423	431	465	481	511	134	242	439	444	483	435	399	457
280	244	388	407	414	409	431	449	446	415	424	428	420	423	431	468	482	511	134	244	439	444	484	435	399	458
290	245	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	135	245	439	444	485	435	399	460
300	246	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	136	246	439	444	485	435	399	460
310	246	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	136	246	439	444	485	435	399	460
320	247	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	137	246	439	444	485	435	399	460
330	248	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	137	246	439	444	485	435	399	460
340	248	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	137	246	439	444	485	435	399	461
350	249	388	407	414	409	431	449	447	415	424	428	420	423	431	470	484	511	138	246	439	444	485	435	399	460

Appendix G - Socio-Economic Analysis Background Information

Estimates of forest industry *direct* employment are based on surveys of TSA licensees and processors of TSA timber about their harvesting, timber consumption and employment. The survey responses provide the basis for calculating coefficients of direct employment per '000 m^3 in silviculture, harvesting and processing. The ratios are expressed as person-years[40] (PYs) per '000 m^3 of harvested timber.

Direct employment is calculated at the TSA and provincial levels as follows.

- TSA direct employment consists of employees and contractors who are engaged in TSA forest industry work and who reside in communities within the TSA.
- Provincial direct employment consists of employees and contractors who are engaged in TSA harvesting and silviculture and who reside within the TSA plus those who come to the TSA to work in harvesting and silviculture.
- Provincial direct employment also consists of employees and contractors who are engaged in processing TSA timber outside of the TSA and who reside outside of the TSA.

Estimates of TSA forest industry *indirect and induced* employment are achieved by multiplying TSA *direct* employment by indirect and induced employment multipliers that are calculated by BC Stats. The indirect and induced multipliers are assembled from information contained in the BC Government's Input-Output (I/O) model and the 2001 Census. Following is a table that presents Invermere TSA and province-wide indirect/induced and total multipliers for the forestry, wood saw milling and pulp and paper processing industries. Multiplying the aforementioned direct employment coefficients by the indirect/induced multipliers yields a total direct employment coefficient.

Table: Provincial and TSA Indirect/Induced Forest Industry Multipliers

	Harvesting & Silviculture	Pulp & paper	Other Wood Processing
Provincial level multiplier	1.77	2.83	2.78
TSA level multiplier[41]	1.27	1.62	1.43

Source: Home March 2004 and author's calculations

Forest sector employment income estimates were calculated by multiplying the direct forest industry employment estimates by Statistics Canada 2001 Census employment income data for BC harvesting, silviculture, pulp making and saw milling industries. Indirect and induced employment income estimates were calculated by multiplying the indirect and induced employment by the BC all industries average employment income from the 2001 Census.

Economic activity estimates calculated with the aid of employment coefficients per '000 m^3 of harvested timber and indirect and induced multipliers include the following assumptions and caveats.

- The future employment estimates are based on current labour productivity relationships, despite knowledge that labour productivity in the forest industry improves slowly over time. These employment estimates, which use current productivity relationships, are satisfactory in the short-term but in the medium- and long-term are likely to be slight overestimates.

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[40] A person-year of employment is a full-time job that lasts at least 180 days per year. The surveys of licensees and processors capture information about part-time jobs; they are converted to equivalent full-time person-years of employment in the employment estimation.

[41] This multiplier incorporates the assumption that employment insurance and other social safety net programs to employed and displaced workers will temporarily encourage them not to leave the community, thereby reducing the induced impacts of a lower harvest level.

- Changes in harvest levels are posited as the main driver in employment changes. For the harvesting sector, this assumption is correct but silviculture and processing sectors have other forces that are also important drivers of employment change. For the processing sector, employment changes are likely to occur discontinuously in "lumps" rather than continuously with small shifts in timber supply. The employment coefficients do not take into account the other forces that drive change in silviculture and processing. Despite this shortcoming, the approach of using employment coefficients and multipliers is valid for the purposes of comparing alternative scenarios for processing as well as harvesting sectors.

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